

Stay alive

A HANDBOOK ON SURVIVAL

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FOR SUE AND LYN
WE SURVIVED

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Preface

The publishers first decided to produce this manual following suggestions from a number of Commonwealth government departments and authorities who saw a need for a comprehensive guidebook on survival for public servants engaged in field work. Foremost was the Bureau of Mineral Resources, which had already produced a draft manual, based mainly on information received from the army.

Although produced in the first instance to satisfy a need within the Public Service, *Stay alive* attracted a much wider audience, selling 42 000 copies in two and a half years.

Stay alive gives advice on survival in situations likely to be encountered in Australia and its surrounding waters. It does not consider hazards which may occur in other parts of the world, even in neighbouring countries such as Papua New Guinea.

The Australian Government Publishing Service wishes to thank the many government departments who supplied material. Many works on survival produced by foreign governments and commercial publishers were also examined; where quoted these are acknowledged in the text, as are the sources of photographs.

The index was prepared by Mr H. Godfrey Green.

The author and publishers would like to thank all those readers who have suggested changes, modifications and improvements. The main changes in the second edition were to the section on first aid, with other minor amendments. This third edition incorporates new material on surviving, changes to first aid practice in the treatment of stings and bites from dangerous marine animals, and additional material on bushwalking, travelling outback by car, and bushfires.

New colour illustrations are included for some of the dangerous marine animals, and distribution maps have been provided showing where they are likely to be encountered. Distribution maps have also been provided for the edible plants, and we are grateful to the National Botanic Gardens for supplying these.

This third edition is being produced in two versions, one on conventional printing papers and the other on a biaxial polypropylene synthetic stock for use in harsh or wet conditions, such as in boats, in the snow or out in the bush.

This is a book about survival. Defined bluntly, survival means staying alive. For the purpose of this book it means preserving your life against any immediate peril, such as drowning, starvation, dehydration, oxygen deficiency, heat and cold.

The aim of this book, then, is to advise you on techniques for staying alive if by some mischance you are caught in one of the typical survival situations, such as an aircraft crash, a shipwreck, car breakdown in the wilderness, a natural disaster, or getting lost in the bush. It also offers useful general advice on such things as first aid and dealing with a car smash. This is neither a comprehensive manual of survival nor a specialist handbook. It is a compendium of useful advice for the ordinary person. It doesn't, for example, try to cover every survival situation nor does it try to deal in detail with every survival technique. It doesn't offer detailed advice on the use of survival equipment supplied by the defence forces. It doesn't explain what to do during an air emergency. Generally it concentrates on what to do after emergencies. Many people survive disasters but fewer survive the period that follows. Following World War II the loss of 448 British Merchant Navy ships between 1940 and 1944 was analysed. The analysis showed that only about one-fifth of those who died were killed as a direct effect of the incident that wrecked their ship. Of those shipwrecked about one-third died. About one-quarter of these deaths occurred when the shipwrecked person was in the water. A few died of drowning. But most died of hypothermia—subnormal body temperatures. The period after a disaster is often more dangerous than the period of disaster itself.

It is a well-established fact that the will to survive is the main factor in successfully surviving most disasters. But it is also well established that preparedness and knowledge help, not least because they strengthen the will to survive. A French doctor, Alain Bombard, who made survival training his life work, estimated that of the 200 000 people who die at sea each year, 50 000 die from lack of survival training in the boats provided to save their lives. American defence authorities estimated that the main reason for the deaths of 2700 GIs imprisoned during the Korean War was inadequate survival training. An analysis of 4000 aircraft survival experiences showed that a successful survivor must:

1. be mentally prepared for the fact that he will go down;
2. be in a good physical condition;
3. have survival equipment attached to his parachute harness or accessible in the aircraft;
4. be able to use it;
5. be dressed for ground conditions;
6. be thoroughly familiar with bail-out, ditching and crash landing procedures;
7. be proficient in guiding and getting out of a parachute;
8. be able to get food, water and shelter in environmental extremes.

At the top of that list is mental preparedness. It is at the top of every list of survival skills and it is here that a survival manual can help. As the Canadian Air Force's survival manual, *Down but not out*, puts it, 'In recent years many advances have been made in the development of clothing, equipment, and rations for survival and of techniques for their use. However, regardless of how good equipment is or how good the techniques for its use are, the man faced with a survival situation still has himself to deal with. Man's psychological reactions to the stresses of survival often make him unable to utilise his available resources.' That is why the Royal Australian Navy urges its men to imagine themselves in survival situations and to plan their courses of action. It is why the Navy stresses

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will power as the key to survival and lists these factors as being the most important after a disaster: pugnacity, tenacity, stubbornness, self-reliance, self-control, love of life, confidence in the ability to survive, faith in outside help, adaptability to the environment, an ability to divert the mind from the immediate environment, an equable temperament, mental and emotional stability, and a sense of comradeship.

There are three main phases in most survival situations and seven main enemies of survival. The first phase, lifesaving, is when you have to get out of your crashed aircraft or wrecked ship and seek the safety of a liferaft or distance from a fire or potential explosion. The second is the signalling phase in which you operate or establish whatever signals are available to you so that you can communicate with rescuers. The third phase is the search for shelter and subsistence.

The seven enemies of survival listed by the Canadian Air Force are pain, cold, thirst, hunger, fatigue, boredom and loneliness. To these might be added fear.

Pain

No one enjoys pain but many survive it. In survival situations many also forget it or conquer it. Once you give in to it your will power will be weakened and your chances of surviving will diminish. One of the survivors of the HMAS *Armidale* in 1942 recalled how pain, hunger and thirst demoralised the survivors on their third night: 'We were beginning to wonder just what was going to happen to us, our hunger and thirst were increasing and the salt water and coral dust which got into our small cuts and abrasions were making them very painful. I suppose those facts were really the cause of the nearest we came to panic during the whole of our ordeal.'

One of the survivors of the MV *Bintang*, torpedoed in 1942, recalled:

One affliction which we all shared was saltwater ulcers and what is commonly known as boat feet. We had all received cuts and bruises in our struggles when the ship foundered, particularly on the large incrustations of barnacles on her

lower sides and bottom. The fuel oil and salt water and burning sun had so irritated these cuts that they became septic and extremely painful; another affliction was that none of us could have a bowel movement. Not unnaturally, our state of health was fairly pitiable by the time we were picked up. Our ribs were beginning to stick out to a painful degree. At night time the temperature would drop to between 60° and 70° F. This to people at home may seem quite warm, but after an average daytime temperature of 120° F in a burning sun this nightly drop of temperature sorely taxed our weakened constitutions. At night we crowded together for warmth, but as the raft was awash all the time this meant trying to sleep in about three inches of water with soaking wet blankets for a covering. Every now and then a really big wave would wash over us, and we would be aroused out of our stupor, shivering and miserable. This state of things so played upon our nerves that by the end of the first week we were the most temperamental and miserable human beings imaginable.

Pain sometimes drives survivors to thoughts of suicide as it did to the American William Willis who in 1954 crossed the Pacific Ocean on a large wooden raft. During his 10 800 km journey he suffered acute stomach pains, but he survived :

And then a tiny voice began to whisper that I was myself to blame for what was happening to my body. Take the pain or go over the side. Cut it out with a knife. It has drawn most of your life into its grip. My eyes kept going to the thin-bladed fish-gutting knife stuck above the door of my cabin. You have a knot there tight as steel, and still tightening—you must cut it. Strange how this idea fascinated me. But how could I cut into my body? It would possibly bring relief from the pain, but then I would have a hole in my body. For hours my thoughts dwelt on soldiers on the battlefield shot through the stomach, lying in some gully or in deep grass incapable of movement, waiting in agony to be picked up. Fight it out, Bill—this is nothing—fight it out, man!

When in 1951 Alain Bombard set out to demonstrate that castaways could endure more than was supposed and still

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survive if they knew what to do, he subjected himself to severe pain and privation as he drifted across the Atlantic in a dinghy. He lost 25 kg in weight. He suffered severe itching when he developed a rash all over his body. Small pockets of pus formed under his fingernails. He became seriously anaemic. His blood pressure varied greatly. 'I was racked with diarrhoea for fourteen days ... with sizeable haemorrhages. I nearly lost consciousness on two occasions ... I lost the nails from my toes. I developed serious defects of vision, suffered a marked loss in muscular tone, and was hungry. But I got there.'

Cold

Pain is often no more than a severe discomfort to be endured, but cold can be a killer. Some people can endure it longer than others but everyone who continues to lose body heat to the environment will eventually die. Some have survived immersion in water around freezing point for 14 hours, while others have died within minutes. Some have survived subzero temperatures on land for days while others have died within a few hours. It is easier to survive cold if you are wearing dry, warm clothing than if you are wearing light clothing. It is much more difficult to survive if your clothing is wet or you are subjected to cold wind. If you are immersed in cold water, you will lose body heat more rapidly than if you are subject only to dry cold, but it is still possible to survive extremes, at least for a short time. There is one British record of a fat man of 29 who remained swimming in the Bering Sea in July for between 9 and 14 hours with the sea temperature at minus 1°C. But there are also many records of people dying within half an hour of immersion at that temperature.

A survivor of HMAS *Armidale* recalled how he and his fellow survivors felt cold even though the water was moderately warm: '... the breeze made us shiver, and when you are up to your neck in water I guess it does not make much difference, you still feel cold'.

Cold is not only associated with a lowering of body temperature but also with a reduction of will power. The suffering it

causes, and the limitations it imposes on action, numbs the mind and numbs the will. Writing of his experiences alone on the Ross Sea Barrier, Admiral Richard Byrd said :

There is something extravagantly insensate about an Antarctic blizzard at night. Its vindictiveness cannot be measured on an anemometer sheet. It is more than just wind; it is a solid wall of snow moving at Gale force, pounding like surf. The whole malevolent rush is concentrated upon you as upon a personal enemy. In the senseless explosion of sound you are reduced to a crawling thing on the margin of a disintegrating world; you can't see, you can't hear, you can hardly move. The lungs gasp after the air sucked out of them, and the brain is shaken.

Consequently it is of the utmost importance for a survivor to keep warm, not only to conserve his body heat but also to preserve his all important will power.

Thirst

Thirst is often associated with surviving in heat. Heat alone is rarely a killer. When it kills, it is usually indirectly, as a contributing factor to dehydration. Dehydration occurs when body fluid lost is not replaced. In a hot climate much fluid is lost in sweat because body temperature is maintained by evaporation of sweat from the skin. Fluid loss increases with exposure to direct sunlight and with activity. A person must replace the fluid lost if he is to survive. This applies to cold climates as well as hot. The only difference is that you can survive longer on less water in the cold. Although it is possible to survive at temperatures between 10 °C and 21 °C for up to 10 days without water, the body will need about 2 litres a day to maintain its water balance if even light work is done. ■

Like pain and cold, thirst can dull your mind and numb your will power—even make you demented. A survivor of the *Armida* recalled a thirsty Sunday morning spent rowing a leaking boat over an oily sea :

Our tongues were really beginning to hang out by this time and for a while we tried sucking the buttons on our shirts. It was not bad either. The buttons made a little saliva, but

they finished in breaking up in your mouth. We sucked them for about half an hour, then we found our button supply had been exhausted . . . During the [following] morning we had another 'feed'. Two tins of bully beef amongst twenty-nine, but still nothing to drink. We were all very silent now, thinking, like myself I suppose, of home, and too tired and thirsty to talk.

But their luck changed when they were caught in a squall of rain. In a survival situation small things can suddenly change a man's outlook on life :

In a second the rain was beating down, it rained that hard a milk tin filled up in a matter of a minute or so; you can imagine how we revelled in it. While waiting for a tin to fill up we would lick the drips off our arms, the gunwales of the whaler, anything at all to relieve our terrible thirst. The rain could not last for ever, though, and after half an hour it ceased; not before we managed to collect some in a bent piece of tin, however, which we stored in a blimp with the end cut off. We all felt much better now and we started rowing once again with renewed vigour.

Thirst is a major problem for survivors. Hunger often is not, as it is possible to survive for many days without food whereas water is essential to survive for more than a few. But more important than either water or food is the will to survive. A man stranded for 8 days in the Arizona desert without food or water travelled 240 km in temperatures of up to 49°C. The loss of body fluid reduced his weight by 25 per cent. He crawled the last 12 km. When doctors examined him they found his blood to be so thick that he didn't even bleed from his cuts until he had drunk a lot of water. He had broken almost every rule of survival but he survived through sheer will power.

A survivor of the torpedoed British steamer *Umona*, a gunner, recalled that after he ran out of water he began to have hallucinations, something that caused him and his fellow survivor, a passenger, considerable difficulties as they drifted on a 1.5 m square, partly submerged float :

I dreamed that I had a cup of tea, and when I awoke I told the passenger I was going below for a cup of tea. I got off the raft and dived under, then he dragged me back and asked me what I had found. I said I had gone down the wrong way and promptly went over the other side. Three times I did this, and each time he had a terrific struggle to get me back on the float.

The gunner and the passenger survived. They had only one biscuit for 13 days and no water for the last $5\frac{1}{2}$ days. Fortunately they avoided drinking sea water, something that most of the survivors of the torpedoed SS *Lulworth Hill* failed to do. They had plenty of sea food but were tormented by thirst. As they surreptitiously drank sea water they imagined that they saw rivers of ice and snow. Three of the fourteen jumped overboard and others became violent. During 33 days on a raft some of them died insane, some of despair and exhaustion. One of the two who survived said he had managed it by will power.

Fatigue

Fatigue makes people careless and uncaring. It sometimes leads to, sometimes results from, hopelessness, listlessness, dissatisfaction, frustration or boredom. Weighed down with fatigue, survivors forget to check and maintain their equipment, neglect their watches and their signalling, and fail to perform tasks which help them to survive. Even the great Admiral Byrd, alone in his Antarctic shack, was reduced at one stage to thinking he would die. He tried to do the routine jobs slowly and mechanically but kept lapsing into unconsciousness. One evening, he records :

I dropped into the chair, convinced that the end was near. Up till now I had been sustained by a conviction that the only way I could nullify my mistake and make reparation to my family was by transcending myself and surviving. But I had lost. I flung my arms across the table, and put my head down, spilling a cup of water I had in my hand. My bitterness evaporated, and the only resentment I felt was concentrated

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on myself. I lay there a long time, sobbing, 'What a pity, what an infinite pity.'

After 'five everlasting, interminable days' Byrd realised that he need not die, then resolved that he must not die, and began to take practical measures to ensure that he didn't.

Boredom and loneliness

These feelings often lead to feelings of listlessness or fear. Many survivors' accounts attest to the insidious nature of listlessness which often becomes hopelessness.

Fear

The lonely man lost in a strange environment is naturally fearful. In *The survival book* P. H. Nesbitt, A. W. Pond and W. H. Allen say that fear is common to all the psychological obstacles to survival—'fear of the unknown, fear of discomfort, fear of people, and fear of one's own weaknesses. We fear the terrain and the climate because they're new and strange. Fear of the environment leads us to fear the discomforts we may suffer and the strange people we may meet. Moreover, even though we overcome these fears to some extent, a lack of confidence in our own fortitude and ability may seriously weaken our will to survive.'

As the Canadian Air Force says, 'One of the most important psychological requirements for survival is the ability to accept immediately the reality of a new emergency and react appropriately to it... self-confidence is important in handling fear and panic, survival information should serve to minimise fear and prevent panic.'

One way to overcome fear, boredom and loneliness, and at the same time forget pain, cold, thirst, hunger and fatigue, is to do something. This is not a recommendation for great physical exertion. As many parts of this book show, rest is very often more important than exertion. It is a recommendation, however, for you to use your initiative. In 1942, a Chinese steward from the *Ben Lomond* survived 133 days at sea on a raft. He had food and water which sustained him for 50 days.

Then he extracted a nail from the raft planking with his teeth and shaped it into a fish hook. He used the raft's lifeline for a fishing line and baited his hook with biscuit paste to make his first catch. He used this as bait to catch fish of up to 23 kg in weight. When the Finnish escapee from the French Foreign Legion, Ensio Tiira, found that he had lost his knife on the eleventh but had captured a turtle on his twelfth day on a raft, he was not discouraged by the pessimism of his Swedish companion, Fred Ericsson. Tiira remembered that they had a mirror. He broke it against the sides of the raft and hacked away at the turtle's horny skin for over an hour before he could break it. He ate and survived while his companion refused the food, lapsed into pessimism, lost the will to live, and eventually died.

Having something to do is possibly even more important if you are in a group of survivors. The Canadian Air Force says that a crew's chances of surviving depend largely on its ability to organise activity. High group morale exists when all crew members feel themselves part of the crew rather than individuals. It lists these as important factors in successful group survival: organisation of manpower, selective use of personnel and their skills and abilities, the leader's willingness to accept suggestions and criticisms, the ability to act wisely in the time available, care in checking equipment, the ability to solve problems after surveying the whole situation, knowledge of survival skills and adequate reaction speeds.

One of the survivors of the *Armidale* told of how fifty-four men took turns on a raft and resting in water up to their chest on a sunken whaler. Then a leading seaman suggested to the officer in charge that they try to raise the whaler. Here is his story:

I must admit I thought it was hopeless. The whole thing was riddled with bullet holes, and near the stern on one side was a hole extending from the gunwale to the waterline, and about five inches wide. There was nothing left at all in the boat. All the lifting gear had been wrenched out when the force of the water coming up underneath it as the ship turned

over had broken free. There was no compass, no boat bag, no rudder or anything left that would have been useful to us. The first thing to be done was to raise it sufficiently high enough out of the water in order to allow a couple of chaps resting on their blimps to hop inside and bale her out. This was accomplished by the majority of us getting on to the raft so as it floated a couple of feet under the surface, and then hoisting the damaged whaler end on to it. The raft was then cleared and it floated up again bringing the stern of the boat with it. The two balers started in and gradually the bows were clear, supported by another two of the lads.

We then got hold of scraps of canvas, clothing or anything we could find and plugged up the bullet holes as best we could.

Luckily a larger piece of canvas was brought to light which allowed us to patch a big hole. There were no nails available so we set to with our knives and took out a few screws from other parts of the boat. We used these to fix the canvas in place, and the job was completed after an hour's hard work; it is a bit difficult screwing second-hand brass screws into hardwood with knives. Were we pleased to see that whaler floating at last! It was not watertight by any means, but would hold twenty-odd men, so long as a couple baled continuously with two tin hats. Now, instead of changing positions and still remaining wet we could take our turn in the boat and have a fairly dry rest.

All that Friday afternoon, we towed the raft and Carley Float, stokers and seamen alternately pulling at the oars. Now that we had something to do the time seemed to pass more swiftly...

He went on to describe how they made a sail by tying three pairs of overalls together, putting a boat hook stave through the arms, and hoisting it all on the whaler oar.

A study of airmen who ditched in the Pacific during World War II showed that small groups of men showed least tendency to give up hope because they found a common purpose in sharing an ordeal. A member of the Shackleton expedition,

Lionel Greenstreet, suggested that sharing common goals helped members survive :

We always felt that something would turn up. Even though we knew that after the ship went down we only had an even chance of survival, there was always some immediate goal to be achieved and some progress to be made. But even at the worst, we did not speak our minds, and if anyone ever despaired he certainly did not tell us. Those who seemed depressed were jollied along by the rest.

Some survivors have been sustained by thoughts of returning home ; some by their sense of responsibility to their families and friends ; one even staggered through the Australian bush clutching a filthy red scarf his mother had given him, obsessed with the idea that it was his guarantee of survival. Many have been sustained by prayer. As Lieutenant Commander F. West said in *Lifeboat number seven*, 'Praying seems easier when one is in trouble . . .' But most, it would seem, have been sustained by their love of life, by the will to hold on because they feel it is better to live in misery than to die in despair.

This book can't give you the will to go on living. It may, however, teach you some of the skills necessary. But it is important to realise that these skills should be allied to something akin to what in the Victorian age Samuel Smiles called Character. Wilfrid Noyce, the mountaineer who wrote a fine collection of tales about survivors (*They survived*), was bewildered when he visited the library of the Scott Polar Research Institute at Cambridge by the number of books and manuals on survival held there. He had this to say about them :

Basically, the theme of all of them is the same: given adaptability, the human being can cope with almost any situation. It is the unadaptable . . . who go under. To some extent a man can learn to adapt, both through survival 'courses', which put him in some of the situations that might be met, and through books which illustrate the situations that cannot easily be demonstrated.

Disciplines of this sort, suggested from outside, can get one a long way. Self-discipline, that elusive quality, does the rest. It is self-discipline which enables one man, though he has none of the aids, to come through the ordeal, while another, who has all the books, goes under.

Few people yearn to find themselves in a survival situation. It is significant, though, that many of those who have yearned to do so have also learned significant lessons from the experience. One thinks of William Willis who learned that solitude on a raft made the world sink as if it had never been, so that he felt he was floating in space, no longer part of humdrum materialist existence; of Richard Byrd discovering in the Antarctic two things: an appreciation of the sheer beauty and miracle of being alive and an Intelligence in the universe that aimed at harmony and peace: 'The human race, then, is not alone in the universe. Though I am cut off from human beings, I am not alone. For untold ages man has felt an awareness of that Intelligence. Belief in it is the one point where all religions agree. It has been called by many names. Many call it God.'

And one thinks, too, of Thor Heyerdahl discovering on the *Kon Tiki* raft that the world after all was simple and time of little consequence:

We realised that life had been full for men before the technical age also—indeed fuller and richer in many ways than the life of modern man. Time and evolution somehow ceased to exist; all that was real and all that mattered were the same today as they had always been, and would always be. We were swallowed up in the absolute common measure of history, endless unbroken darkness under a swarm of stars.

As few people ever expect to be in a survival situation, few realistically think through what might happen if the unthinkable should occur. It may be worthwhile, therefore, to recall the outlines of a few survival stories.

Perhaps the classic tale of survival of the 1970s was the story, so memorably told by Piers Paul Read in *Alive* (Pan, London, 1975), of the sixteen people who survived a plane

crash in the Andes and lived for 10 weeks in the snow at 3500 metres above sea level before they were rescued because of their own efforts.

The Uruguayan Air Force plane was chartered in October 1972 by an amateur rugby team to fly the fifteen players and twenty-five of their friends and relations from Montevideo in Uruguay to Santiago in Chile. In early spring, while they were flying over the snow-covered Andes, the pilot mistakenly began his descent towards Santiago too early. The right wing of the plane hit the side of a mountain, broke off, and cut off the tail. Five people were thrown out of the plane. Then the left wing and a propellor blade were ripped off and the fuselage ploughed into deep snow in a mountain valley. As it did so, two more people were sucked out. Those who remained inside found their seats breaking loose from their mountings. Some were crushed between seats, some against a partition, and some were injured by metal and plastic. Thirty-two people survived the crash.

There was the usual period of panic and hysteria, then the survivors began to examine their wounds, count the dead and organise themselves into work parties. The pilot died, the radio would not work and the passengers' luggage was lost with the tail.

Sensibly, they made an inventory of food and drink that had survived with them—a few chocolate bars, some dates, dried plums, salted biscuits, two tins of mussels, one tin of salted almonds, one jar each of peach, apple and blackberry jam, and a few bottles of wine and spirits. By then, deaths had reduced to twenty-eight the number of people that had to share this slender supply, so they rationed themselves to a scrap of chocolate, a cupful of wine and a teaspoonful of jam or tinned fish.

Pragmatism, initiative, imagination and learning to make do are elements of many survival stories. The Andes survivors learned to make water by shaking snow in a bottle until the snow melted and by melting it in the sun on a sheet of aluminium foil shaped into a bowl. They made snowshoes out of the seat cushions. And they rigged up an aerial from strands

of wire torn from the plane's electric circuits and attached it to a transistor radio they found between two seats.

As their food ran out they realised that the only way they could survive would be to eat the dead bodies that lay frozen in the snow around the plane. The idea was of course repugnant, but eventually they were driven to cutting thin slivers from the buttocks of one of the bodies, drying them in the sun on the roof of the plane, then eating them. Later they learned to cook the meat on hot aluminium foil and gradually they overcame their repugnance for both their act and the meat. They even made a pact that should they die their bodies could be eaten by the others.

Meanwhile they heard on the radio that the search for their plane had been called off.

One of the passengers, a medical student, operated on wounds with a piece of broken glass or a razor blade, using eau de cologne as a disinfectant and the subzero air as a steriliser. Some of them died in an avalanche of snow which poured into the plane one day and some died of other causes. The sixteen who finally survived endured bouts of constipation and diarrhoea.

Ten weeks later when two of them finally climbed out of the snow-clad valley over a 4100 metre mountain they found their first two signs of civilisation, an empty Maggi soup tin and a pat of cow dung. Attracting the attention of a peasant on the opposite side of a river, one of the bearded emaciated young men wrote a note, wrapped it around a stone and threw it across the stream: 'I come from a plane that fell in the mountains. I am Uruguayan. We have been walking for ten days. I have a friend up there who is injured. In the plane there are fourteen injured people . . .' They slept in a real bed for the first time since the crash 70 days after the plane came down.

When helicopters flew into the valley to rescue the other fourteen survivors a few days before Christmas they found the fuselage surrounded by filthy snow. It was strewn with gutted human carcasses, gnawed bones and split skulls. The survivors had eaten not only the flesh of the frozen corpses

but also the livers, hearts and brains. At times they could neither cook nor dry the meat and had to eat it wet and raw as it came off the bone. All of them had lost between 12 and 25 kg during their 10-week ordeal. All of them stank. Most suffered serious physical debilitation.

All of them were Roman Catholics and when a priest taped interviews with them in hospital they were agreed about three things. 'We had an enormous desire to survive', said one, 'and faith in God. Our group was always united . . . God gave us this experience to change us. I changed. I know now that I shall be different to what I was . . . all thanks to God.' And another of the rugby players said: 'When you make a try, it isn't you but the whole team, that has scored. That's the best thing about it. If we were able to survive it was because we all acted with team spirit, with great faith in God—and we prayed.'

It was the spirit of comradeship among survivors that Dougal Robertson emphasised in his account of surviving shipwreck in the same year as the Uruguayans survived their plane crash (*Survive the savage sea*, Elek, London, 1973). The spirit of comradeship, he said, is far more important in survival than any imposed discipline. 'It is the spirit of comradeship which enables the castaway to suffer extremes of discomfort and even to offer life itself to assist the survival of others . . . only a deep understanding of the need to share discomfort will reconcile the sufferer to pain and prevent him from attempting to better his lot at the expense of others', he wrote.

Robertson, his wife, their three sons and a student survived at sea for 37 days in 1972 after their schooner *Lucette* was attacked by killer whales in the Pacific and sank in 60 seconds. They had an inflatable rubber raft, a 9-foot fibreglass dinghy, food and water for 3 days, no maps, no compass, no instruments and a journey of 538 kilometres to face if they were to reach the coast of Costa Rica.

They steered by sun and stars. While they dreamed of steaks and milkshakes they ate glucose sweets and biscuits and shared a pint of water a day between six of them. Resisting

the temptation to drink sea water, they collected rain and drank the blood of turtles in the 30 seconds before it coagulated. Flying fish leapt on to their raft and they ate them raw. They hauled huge turtles aboard, hacked out the meat, ate some of it raw and dried the rest in the sun. They improvised a fishing line, hauled in a shark, shoved a paddle between its jaws, knifed it to death, and ate it raw.

They stripped a piece of rubber tubing from the raft ladder and used it to pipe unpalatable water into their bodies by enema. They suffered from sores and boils, constipation and cold. But they made 'survival' their code word and they did survive. After 37 days a Japanese fishing boat picked them up 143 kilometres from their destination in Costa Rica.

Reflecting on their experience after the rescue, Dougal Robertson said that survival was the hardest school in life because there were no failures. He rejected the high-sounding phrases of survival manuals about leadership, duty and discipline and wrote: 'In real terms knowledge is leadership, common sense is duty, and the practical observance of survival laws is discipline.' His wife was convinced that a spiritual presence assisted them and that her prayers were more effective than her feats of physical endurance. But Robertson himself believed:

The enormous difference between actively fighting for survival and passively awaiting rescue or death effects a complete change in the castaway's outlook; he becomes master of his fate and will devise means to survive which no textbook can prescribe for him. The best assistance he can be given is good information and reliable material, the rest is up to him, and with sufficient determination he will succeed.

Determination and good information were two of the things that helped sustain Captain Charles Sturt on his expedition into the interior of Australia in 1844-46. In his memorable story of how he survived in heat and desert Sturt stresses that a survivor should never despair, whatever the difficulties he faces and even though his last hope is almost extinguished.

Sturt had good reasons for this conclusion. At one stage he

languished in the desert for 3 months during which the mean temperatures were 38.3°C, 40°C and 38.3°C respectively. The heat caused every screw in his party's boxes to be drawn. The horn handles of his instruments were split into fine laminae. The lead dropped out of his pencils and the ink dried on his pen before he could write. His hair ceased to grow and so did the wool on his sheep. His flour lost more than 8 per cent of its weight and he had to bury his wax candles to stop them from melting.

In 11 months he saw rain only once. He drank water that was sludge and water that was black as ink. He slogged his way across great sandhills and across the Stony Desert. He suffered from scurvy and was blinded. Then one day in November 1845 a withering gale silenced the birds and whipped the leaves from the trees like a snow shower. At noon Sturt took out of his box a thermometer graduated to 127°F [52.7°C] and put it in the fork of a tree where it was sheltered from sun and wind. The mercury rose to the top of the glass and shattered it—'a circumstance that I believe no traveller has ever before had to record'. Twice the temperature exceeded 54°C in the shade and was 71°C in the sun. Day after day the temperature ranged between 43°C and 50°C. The ground was so hot that his matches ignited when they fell upon it. The air was filled with red dust.

Sturt's muscles became rigid with scurvy, his limbs contracted, his skin blackened and finally he was unable to move. He was carried long distances, jolted in a dray. And when on 19 January 1846 he finally reached his home in Adelaide his wife fainted when she saw him.

Reflecting on his experiences, Sturt said that to survive you needed discipline, a basic knowledge of bushcraft and perseverance, even when circumstances were so bad as to drive you to despair. A few weeks later, at a dinner in his honour, he began to tell what had happened to him in the 'fearful desert' but it was too much for him and he broke down and wept.

The water balance

Water is involved in some of the most fundamental processes in the human body and in a survival situation it is even more important than food. Some people survive for weeks without food, but in some circumstances your life expectancy without water may be no more than two or three days. The reasons for this become clear when you understand the part water plays in your body.

The main functions of water in the human body are to transport food to the body cells, help remove waste from them, act as a medium in which chemical reactions occur, and reduce the heat of metabolism. The quantity and concentration of water in the body is important.

The amount of water in a human body varies considerably from person to person but it averages about two-thirds of total body weight. The body of a person weighing 70 kg may contain about 47 litres of water. This water comes from several sources. About half of it may come from drinking, about 40 per cent from the 'combustion' of 'solid' foods (most of which contain water), and the remainder would be manufactured by the body itself as a by-product of the chemical process of cellular respiration. Within the body, water helps to break down food into simpler products which can be absorbed through cell membranes. The products of this process include starch, heat, carbon dioxide, and more water. For example, 300 g of fat may yield slightly more than 300 ml of water whereas 300 g of carbohydrate may yield half that amount.

Water is also a kind of cooling unit for the body. It helps to control the heat of the body's metabolic processes by absorbing



large quantities of heat with comparatively small increases in temperature. It also protects the body's chemical processes from big fluctuations in pressure, acidity and chemical composition.

Thus water is a great stabiliser, but it must be stabilised itself both in quantity and in the concentration of dissolved materials. If you do not consume enough water to maintain the necessary water balance in your body, the effects of your water deficit become apparent. A deficit of 5 per cent of the body's weight may cause thirst, sleeplessness, flushed skin and lack of appetite. A 10 per cent deficit may make walking and breathing difficult and cause headache and dizziness. A 20 per cent deficit may cause delirium, a swollen tongue, inability to swallow, a numb and shrivelled skin, and finally death.

The body is constantly losing water. It loses it continuously in the form of perspiration from the skin and respiratory tract. It also loses it intermittently in the forms of urine, faeces, sweat, vomit and even blisters.

Perspiration helps cool the body as it evaporates from the surface of the skin and an average man in average conditions may lose about 850 ml of water a day by perspiring. His urine loss decreases from (up to) a litre down to 300–400 ml when not provided with drinking water. If he is on an ordinary mixed diet, he may excrete about 70 to 140 ml in his faeces. But he can lose much more than this if he is suffering from diarrhoea, or if his sweat glands are activated. A person sweating in a humid environment may lose up to 3 litres an hour; someone working in 43°C may lose about 6 litres in a day. Moreover, sweating may continue even when the body is seriously dehydrated. A person may also lose large amounts by vomiting and smaller amounts through blisters resulting from severe sunburn. Thus an average person living in equable conditions may need only about a litre of water a day, if allowance is made for that made available by the combustion of food, whereas someone indulging in strenuous exercise or working in a hot climate may require several times that amount.

A person sitting exposed in an open boat in the tropics for

24 hours may lose up to 6 litres of water, mostly as sweat. That person could die of dehydration within 3 days if no more than a litre of water a day were available. If a person is walking in the tropics, his body may lose more than 14 litres, mainly sweat. More than two million sweat glands, which work unnoticed in the body at normal temperatures, increase their activity when it becomes overheated and large amounts of water may be lost as the sweat evaporates and cools the body.

It is clear that the water taken in by the body is not stored there. Water is consumed and excreted throughout the day and the body is continually balancing the amount of water it contains. When water is drunk it is absorbed into the bloodstream. If too much is drunk, some is withdrawn by the kidneys and is passed as urine. If too little is available, the body begins to dehydrate. One of the functions of the kidneys is to help maintain this balance. To survive, a person must balance the loss of water by taking in corresponding amounts.

In an equable environment a person may need only about a litre of water a day whereas a minimum of 4 litres a day may be needed in a hot desert. But those 4 litres can be made to go further if certain basic conservation practices are followed. The best way to conserve your water is to control your sweating. The rule is: Ration your sweat, not your water. To do this:

- Keep your clothes on so that your perspiration evaporates slowly and you get the maximum cooling effect. Loosen the clothing at the neck, waist, wrists and ankles to give maximum ventilation.
- Wear light-coloured clothing if possible, because it reflects the sun.
- Cover as much of your body as possible to avoid sunburn, as blistering causes loss of water.
- Do as little as possible and stay as cool as possible.
- Stay in the shade during the day and reserve necessary physical action for the night. A person standing still in hot sun needs three times as much water as someone standing still in the shade.

- When you move, move slowly.
- Try not to rest on the ground. The temperature may be 16 °C cooler 300 mm above the ground than it is on the ground.
- Take advantage of cool breezes.
- If you are at sea, keep your clothing wet.
- If you have seasickness tablets, use them to prevent vomiting.

If you are in a survival situation with a limited supply of water, the rule is: It's the water in your belly, not the water in your bottle, that will keep you alive. You must maintain the water level. Remember that it is false economy to reduce your consumption of water below your body's requirements. The difference between the supply and the requirement is drawn from your body's tissues. The resulting deterioration in the tissues may lead to death, and it is possible to die of dehydration even though you have drinking water left. This does not imply that water should not be rationed. Some of the Australian armed services have been advised to eat and drink nothing on the first day and then to use 500 ml of water a day. Water should be neither wasted nor hoarded. Death by dehydration is unpleasant, as this account by an American airman rescued from the Sahara Desert in 1941 shows:

At first we felt uncomfortable. We had enough solid food with us, but no appetite. We had become distinctly lazy, real sluggish. We didn't sweat as much as we had done at first—and Bill got the first cramps. I told him to lie down, and gave him our last sip of water to drink, having mixed some salt with it. That seemed to help for a time. Bill couldn't take heat as well as I could, because I had grown up on the edge of the Arizona Desert.

'I feel giddy', he said suddenly, and then complained of headaches, which grew worse and worse. His skin all of a sudden became moist and cool. He lay there, his breath rattling, and his mouth completely dried up. Sometimes he tried to scratch his arms and legs. 'It's itching so', he said. His

body eventually went bluish, and I could hardly understand the words he whispered to me in a thick voice. Once he tried to get up, but immediately collapsed.

Then he fell into delirium. He imagined he was lying by a lake, and was greedily trying to lap up water, but didn't seem to be succeeding. The arm he tried to reach the water with suddenly seemed paralysed. He couldn't swallow, either, his throat had swollen so much.

He kept on jerking about, and by kicking furiously at the slashed wing of our aircraft he gave himself a deep flesh wound. But the dehydration of his body had thickened his blood so much that instead of bleeding the wound closed at once.

In the few lucid moments he had, he was deaf and could hardly see me. His eyes were glassy. His skin began to shrivel. When he had to pass water, he could only manage this with great pain. His skin, however, seemed completely numb. Half an hour later he was dead.

(Quoted by Cord Christian Troebst in *The art of survival*, translated from the German by Oliver Coburn, W. H. Allen, London, 1965, pp. 46-7.)

Various tables of likely survival times in deserts have been published. One of the best known is that prepared by E. F. Adolph and Associates. Dr Adolph found that a person's capacity for survival depends on the temperature of his surroundings, his physical activity during the survival period, and the amount of water he can get. The more work he does, the more water he needs. The higher the temperature, the greater the need for water.

R. C. Hutchinson prepared another table by conservatively combining results from two water tables published during or after World War II (page 24).

Finding and purifying water

The obvious sources of water are rain and supplies on the earth's surface such as rivers, streams, springs, waterholes, soaks and dams.

Desert water table

Condition and max. shade temp	Total water available per person	Approximate survival in days			Approx. distance (in km) that can be covered when travelling
		Resting in the shade at all times	Travelling at night, resting in shade by day		
<i>Hot</i> 37°C and above	no water	2–5½	1–3		30
	1 litre	2–6	2–3½		30
	2 litres	2–6½	2–3½		40
	4 litres	2½–7½	2½–4½		50
	10 litres	3½–11½	3½–6½		65–80
<i>Warm</i> 26°C to 37°C	no water	5½–9½	3–7½		30½–65
	1 litre	6–11	3½–8		30–80
	2 litres	6½–12	3½–8½		40–90
	4 litres	7½–14	4½–10		50–105
	10 litres	11½–23	6½–14		80–145
<i>Cool</i> 26°C and below	no water	9½–11	7½–8½		70–105
	1 litre	11–12	8–9		80–130
	2 litres	12–13	8½–10		90–175
	4 litres	14–16	10½–12		105–265
	10 litres	23–25	14–17		145–290

Source: R. C. Hutchinson, *Food for survival after a disaster*, Melbourne University Press, Melbourne, 1959.

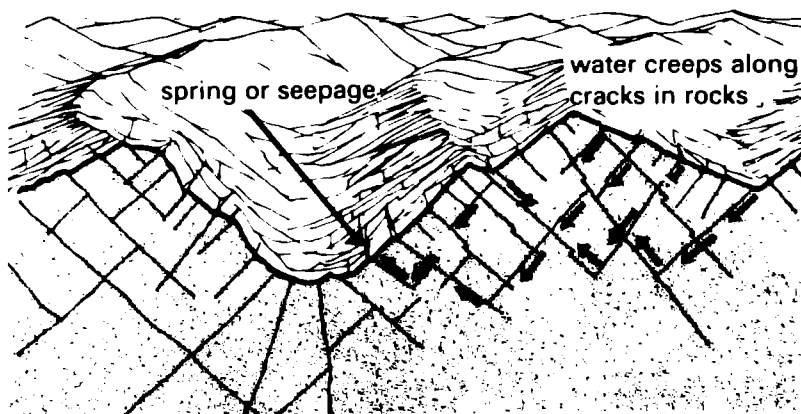
You may collect rain as it falls by storing the run-off from large leaves, collecting it in plastic or metal containers, or in a sheet of plastic. The greater the collection surface, the greater the volume you may collect. If you collect rain in clean containers, it will be ready for drinking. The water in some surface sources may also be pure, but it is safer to assume that it isn't. The rule is to filter and purify water where possible.

24 Stay alive

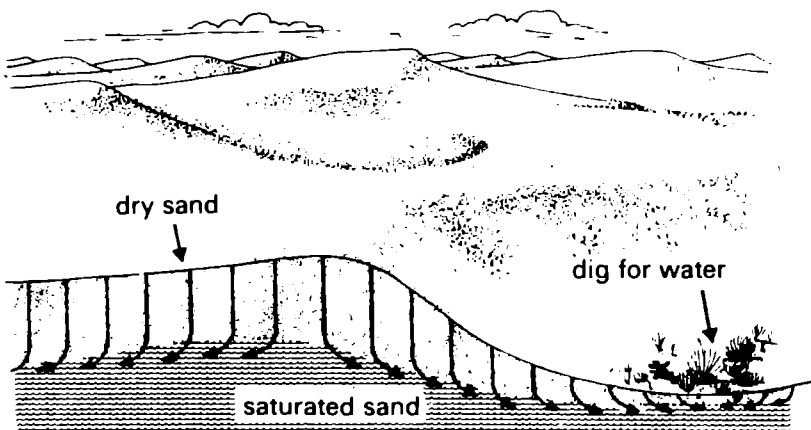
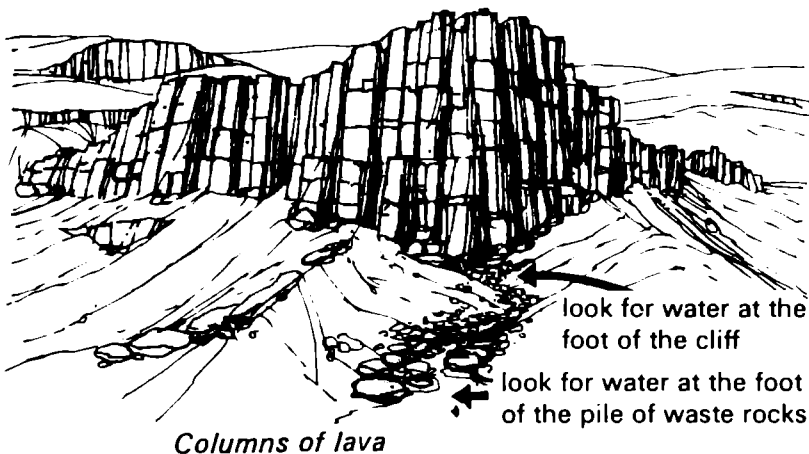
Even if it looks clear it isn't necessarily pure. Boil it for 5 minutes, or use water purification tablets if you have them (stericaps, halazone, chlorine), or add eight drops of $2\frac{1}{2}$ per cent solution of iodine to a litre and leave it to stand for 10 minutes before drinking. One or two small Condy's crystals to a litre will also purify water. Allow it to stand for 30 minutes. Some of the taste may be restored by pouring it from one container to another for a while.

Water found in free-flowing streams may be pure, but if they are coastal streams, they may be polluted by manufacturing or urban wastes. The water from muddy streams may be partly cleared by allowing it to stand overnight. It may then be filtered through several thicknesses of cloth or allowed to seep through a bank into a hole dug 300 mm away. Water from waterholes, animal watering places and large rivers should be filtered, allowed to stand, and purified. If you must drink from dirty or stagnant water and can't purify it, try placing a handkerchief on the surface and drinking through it.

Water may be found in limestone springs and caverns, in rock pools and in narrow clefts. It is sometimes found seeping through lava rocks and in springs in valley walls.

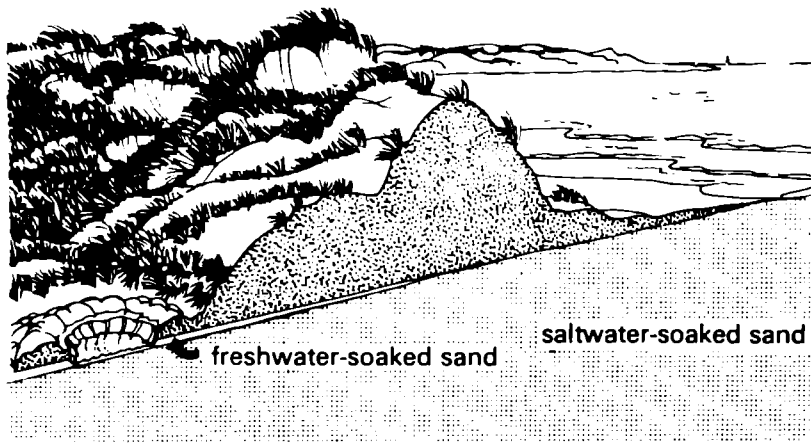


Desert mountains of crystalline rock



Dig at lowest point between sand dunes

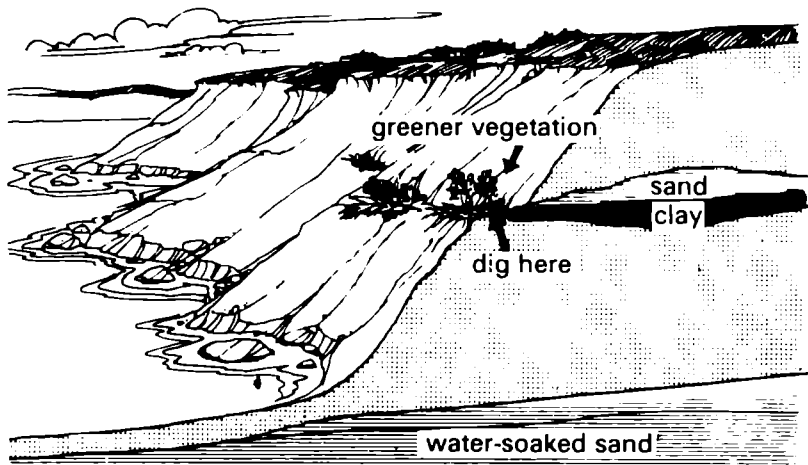
If you can't find water on the earth's surface, try tapping ground water, which is the water flowing or lying beneath the surface. On the coast it may be found in the hollows between sand dunes, by digging behind sandhills, or by digging holes in the sand at low tide about 100 metres inshore from the high tide mark. Dig until you see the first sign of water, then allow it to seep into the hole. If fresh water is mixed with salt water, the fresh water will be found on top. Digging too deep may yield



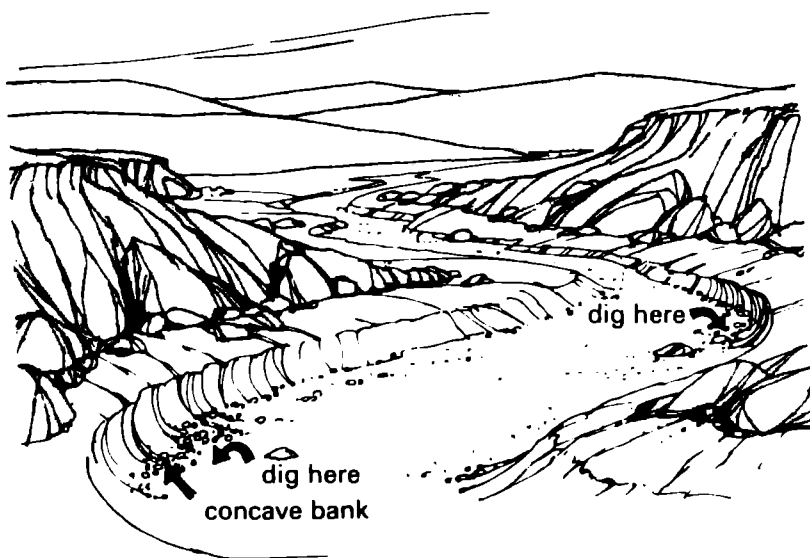
Dig behind first sand dune

salt water as the fresh water may be a layer of no more than 50 mm on top of the heavier salt water. Other good places to dig are at the base of cliffs and rocks where vegetation seems to be thriving, or in dry mudholes. Dig at the lowest point on the outside of bends in dry riverbeds. Dig anywhere the ground is damp or muddy. The water table is normally close to the surface in river plains, low forests and along the seashore. When you dig for water be sure that you aren't digging blindly. Dig only where you see signs that water is there. Above all, don't deceive yourself that you are a water diviner. Forget forked sticks, magic switches and twitches of wire. Your body may need the water you waste on fruitless digging.

Don't neglect dew as a source of water. If you are stranded with an aeroplane or motor vehicle mop up the dew on it each morning with a clean rag and squeeze it into a container. Some people have tied rags or tufts of grass to their ankles and walked through grass before sunrise. Others have drained it from plants and mopped it up from stones. One person may mop up as much as a litre of dew in an hour. Some people dig holes (dew pits), line them with plastic, and place a smooth or shiny object in them. The dew forms on the smooth object and runs into the plastic-lined pit.



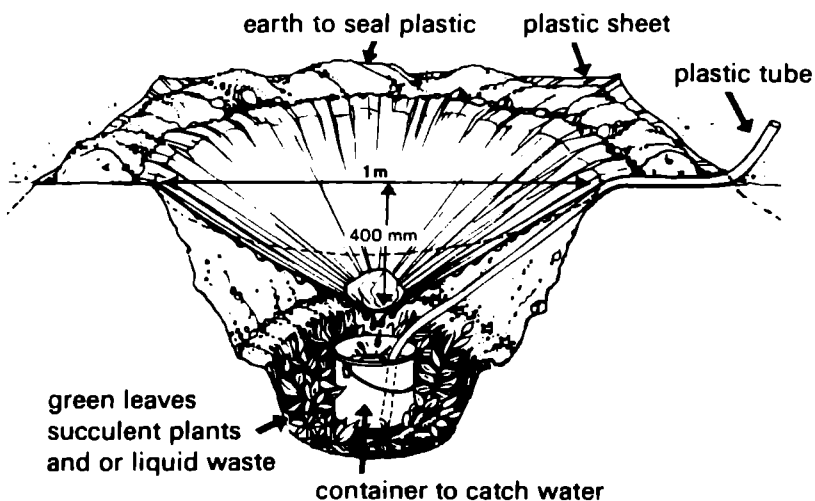
Water may be held in a strip of sand above clay



Dry river bed

Water may also be obtained in desert areas from condensation in solar stills. To make one you need a sheet of plastic about 1–2 metres square, a water container such as a billycan or plastic bucket and, if you can get one, a plastic drinking tube. You dig a hole a little less than a metre square (the exact dimensions will be determined by the size of your sheet of plastic) and about 450 mm deep. The sides should slope at about 45 degrees so that they don't cave in. At the bottom of the hole you place your water container and into the hole you can place leaves and plants and any waste liquid, including urine. If you have a plastic drinking tube, place one end in the container and stretch the tube up one side and over the edge of your hole. Then stretch the plastic sheet across the hole and allow it to hang in the hole without touching the sides. If necessary, some sticks may be used to prop it clear. The plastic sheet is held in position, and the hole is sealed, by placing dirt along its edges and the centre of the sheet is weighted down with a rock.

The solar still makes water by evaporation and condensation from the ground, the leaves and the waste fluid. The water

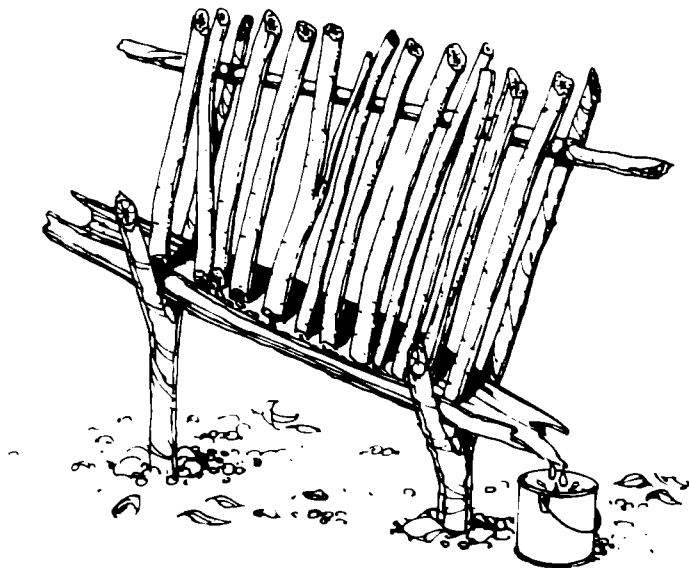


Solar still

condenses on the underside of the plastic sheet and runs down the sheet into the container. Depending on the area, it may make from one to two litres a day. The water may be drunk from the container through the plastic tube without disturbing the still. Several holes may be necessary to provide enough water for one person each day and new stills must be made every three or four days as the old ones are exhausted of their moisture. In some areas small frogs, lizards and snakes may be attracted to the stills, thus providing food along with the water. If you are making solar stills in the desert, remember to ration your sweat and dig them at night.

Water may also be obtained from trees. Two of the best known water trees are the baobab of the Kimberley region of north-western Australia and the Queensland bottle-tree. Water may be extracted from the baobab by cutting a strip of bark from the trunk and extracting pieces of the spongy sapwood beneath the bark. These can be chewed and each mouthful may yield the equivalent of about a teaspoonful of water. The Queensland bottle-tree may yield water if a V-shaped cut is made in the bark and into the sapwood. Water will drip from the bottom of the V and a leaf may be used as a funnel to direct the flow into a container.

Although the baobab's capacity to yield life-giving water is well known, it is not so well known that the roots and branches of many other trees, including many eucalypts, the she-oak and bloodwood wattle, will also yield fluid. Roots several metres long and only a few millimetres below the surface may be ripped up, cut into metre lengths, be stood in a bark trough and allowed to drain from there into a pannikin or billycan. The fluid, like all vegetable fluids, should be drunk on the day on which it is obtained as it goes bad when stored. To get a flow it is important to cut the roots or branches into short lengths. As a general rule, fluid from trees may be drunk if it is colourless and tasteless. If it is a milky sap, regard it as potentially dangerous. The same rule also applies to fluid obtained in a similar way from vines. To get fluid from vines, cut the vine as high as possible, then cut it off close to the ground, then cut it into metre lengths. Allow the fluid to drip



Cut roots of trees



Water is more plentiful from plants in gullies than on ridges

into a container or directly into your mouth, taking care that the vine doesn't touch your lips as this may irritate them. When the fluid ceases to drip, cut off the top third of the piece and more liquid should drip from it.

Some fleshy plants such as pigface, pigweed and cactus-like plants will also yield fluid. It is best to crush it from them into a container, although thirsty men have sucked it directly from them. One American survival expert said that sucking a cactus was like drinking glue and the same may be said of sucking many other fleshy plants.

A sugary fluid may also be obtained from burie, coconut, sugar and nipa palms. The fluid of a coconut palm will flow if you cut off the flower stalk and bend it downward. Coconuts themselves are a source of fluid. You will get the best drink from green coconuts which contain more milk than the ripe ones. As the milk is a laxative, you should drink no more than a litre a day. Coconuts may be opened with a knife. If you have no knife, sharpen both ends of a stick, drive one end into the ground, bash the coconut against the other end to crack the outer fibrous covering, then smash the inner shell against a rock or tree.

Water indicators

Bees are a good sign that water is near, but the water might be anywhere within a radius of several kilometres, so you should look for other signs as well.

A column of ants may also indicate the presence of water. If the column is on a tree, you will probably find a small reservoir hidden within the tree.

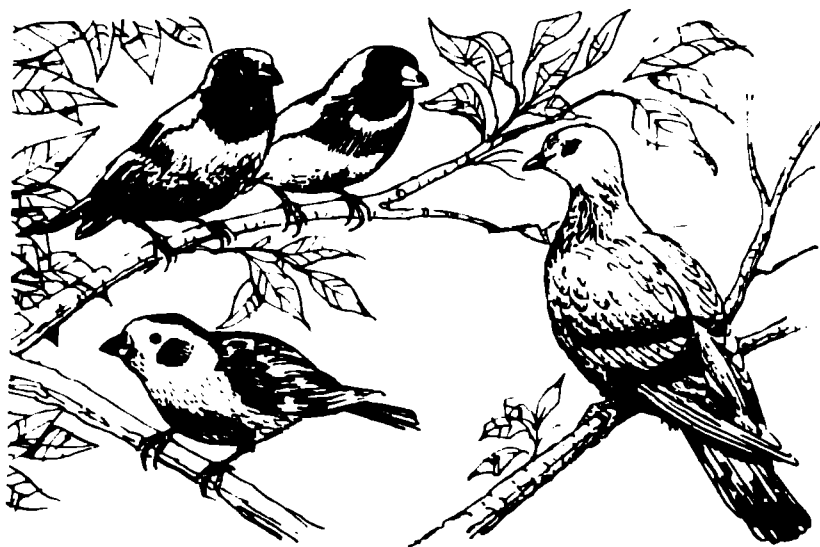
Hornet-like mason flies are another indication. They normally build their nests close to a soak or wet earth. Dig where they alight to roll a pellet of mud for their nest.

Grain-eating birds such as finches and wild pigeons need water as well as grain. Watch the direction of their flight around dawn and dusk and follow it.

Animals also need water so follow any well-developed game trail. If two or more trails converge, they will probably lead to water.



Ants may indicate the presence of water



Birds may be followed for water

Dos and don'ts of water

Do . . .

Try to consume enough water to replace your body's losses.

Conserve your water by rationing your sweat.

Stay in the shade and remain still on hot days.

Leave physical exertion until the night.

Keep your clothes on in the heat. Loosen them.

Rest above the ground.

Purify water chemically or by boiling or filtering.

If you can't find surface water, dig for it.

Mop up dew.

Make solar stills.

Seek water in trees and tree roots and branches.

Look for bees, ants, mason flies, grain-eating birds and animal trails.

Remember it's the water in your belly, not what's in the bottle, that will keep you alive.

Don't . . .

Drink urine or sea water.

Ration water below your body's losses.

Drink polluted water.

Drink water from a radiator containing anti-freeze or rust inhibitor.

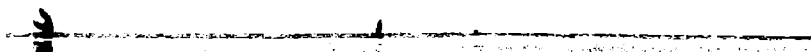
Dig unless you have some indication of water.

Dig in the heat of the day.

Kid yourself you are a water diviner.

All is grist

In his chapter on finding food in *The bushman's handbook* (Angus and Robertson, Sydney, 1948) H. A. Lindsay says you can identify a man who has never really been hungry if he admits that he doesn't fancy witchetty grub. His point is a good one. To survive in the bush you must be prepared to eat almost anything that swims or crawls, flies or walks. Even so, some people who have been prepared to do just this have failed to survive. The explorer Ludwig Leichhardt, for example, would try almost anything. At one time or another he dined on roasted crow, fried emu and stewed green hide. 'Oppressed by hunger', he wrote, 'I swallowed the bones and the feet of the pigeon, to allay the cravings of my stomach. A sleeping lizard with a blunt tail and knobby scales fell into our hands, and was of course roasted and greedily eaten.' He also wrote of the joys of fried emu: '... we cut part of their meat into slices, and dried it on green hide ropes; the bones, heads and necks were stewed: formerly we threw the heads, gizzards, and feet away, but necessity had taught us economy; and, upon trial, the feet of young emus were found to be as good and tender as cow-heel.' He found roasted crow to be exceedingly tender and ate many of the birds. Stewed wallaby needed a little reinforcement, however: 'We enjoyed most gratefully our two wallabies, which were stewed, and to which I had added some green hide to render the broth more substantial. This hide was almost five months old, and had served as a case to my botanical collection, which, unfortunately, I had been compelled to leave behind. It required, however, a little longer stewing than a fresh hide, and it was rather tasteless.' At another time he and his party



feasted on twenty-nine flying foxes. Despite his willingness to eat almost anything Leichhardt did not survive. He disappeared without trace.

In 1912, during an expedition to the Antarctic, Douglas Mawson was reduced to eating the Greenland husky dogs he had taken with him. 'Winter quarters are 300 miles away and we shall not get through unless we eat the dogs,' he wrote. 'We are terribly handicapped.' He and Dr Xavier Mertz had been out exploring for 5 weeks and they estimated it would take them 5 weeks to get back. 'There are roughly 10 days of normal sledging rations,' Mawson wrote, 'and so we must reduce our normal intake of 34 ounces a day down to 8, and pray that the dogs^d give us enough nourishment to keep marching at a rate fast enough to get us through.' Mawson shot the dog George through the brain with a .22 rifle, fed half the carcass to the other five huskies, and kept the leg muscles and liver for himself and Mertz. When they tried to fry the two hind-leg muscles in the lid of their Nansen cooker they found there was so little fat left in the starved dog's body that the meat only scorched on either side. Mertz hated the musty, sinewy meat, but ate it. Mawson said it was 'quite good'. Later, they managed to scorch the liver in the lid. They blackened the outside but inside it was still pink and raw. 'It is better for you like this—not to cook the goodness from it,' Mawson wrote, unaware that the dogs' livers contained an excess of Vitamin A. Twenty years later scientists identified a clinical condition, Hypervitaminosis A, and in 1971 two biochemists in Adelaide showed that 4 ounces [113 g] of the dog liver contained a dose of Vitamin A which was toxic for an adult man. By the time they had eaten the livers of six dogs Mawson and Mertz, between them, must have swallowed about sixty toxic doses of the vitamin. This probably accounted for much of their subsequent physical debilitation, which included stomach pains, stripping of the skin and inflamed cracks around their noses and mouths. As Lennard Bickel says in his book about the expedition, *This accursed land* (Sun Books, Melbourne, 1977), 'It was an intake made all the more

debilitating and dangerous by the lack of other normal foods that would transport the substances to excretion.'

Nearly all flesh, if freshly killed, is safe to eat, says Richard Graves in his bushcraft book, *Food and water (The ten bushcraft books by Richard Graves, Book 4, Dymock's Book Arcade, Sydney, n.d.)*. But by safe to eat Graves does not mean that it may be eaten with no ill consequences. He means that the flesh itself contains nothing that will poison adults, but he warns that many animals are hosts to parasites which may be fatal. He gives the example of a rabbit being infested with parasites of some kind. The rule, therefore, is to thoroughly cook all flesh before eating it as parasites and their eggs are destroyed by heat.

Preserving food

He warns also of food decay. Meat goes bad because of bacterial infection and bad meat may be fatally poisonous.

To preserve meat for long periods sun-dry, pickle, or freeze it. To sun-dry it, cut off the fat, as the fat will go rancid and taint the dried meat if left on it, then slice the meat in strips about 12 mm wide. Thread one end of each strip on to a wire or cane, but don't let the strips touch each other. Hang them over the smoke of a wood fire until the outside is dry. This may take up to a day, but it will protect the meat from blowflies which won't lay their eggs on a dry surface. When the outside is completely dry, hang the strips in the sun for about a day in a dry atmosphere. In deserts, the strips may be wiped dry with a cloth and buried raw and uncovered, without salt, in 150–200 mm of dry sand. Preserved meat may be stewed, made into soup, or eaten raw. Soak for an hour or two before stewing.

Meat may be pickled by cutting it into about 200 gram pieces and putting it into a strong solution of salt and water.

It will also keep well if frozen and kept below 0°C.

Meat which has been boiled or baked will also keep for a short time. Even if it is fly-blown, it may still be eaten. Maggots aren't poisonous. They aren't very palatable either.



Animal tucker

All kinds of animals may provide a survivor with meat. Richard Graves recommends cat, which, he says, tastes like hare. Roasted flying fox, he says, is as succulent as sucking pig, and roasted snake provides white meat of 'delicate flavour'. He adds: 'But you would not say they were palatable simply because the source of the meat to your mind would be repulsive. The rule is that the flesh of all birds, mammals and reptiles is safe to eat, but not all are palatable.'

H. A. Lindsay recommends lizards and witchetty grubs. Most lizards, he says, are good to eat and goannas are especially valuable for their fat. Witchetty grubs, which are the larvae of a large moth, may be found in most parts of Australia. They live on the wood in tree trunks or roots and their presence may be indicated by a heap of sawdust at the base of a tree or by the sickly appearance of a small wattle.



Witchetty grubs

To catch them, you either hook them from the hole which is trickling sawdust by using a bent wire or hooked stick or tear up a small wattle to reveal the grubs around the base of its roots. You may also dig up the roots or explore the roots with a hooked wire. Lindsay says witchetty grubs may be found in wattle trees, blackboy trees, weeping willows, red gums, candle-nuts, milky pines, and some eucalypts. To eat them, withdraw the entrails, because they are full of partly digested wood, by holding the head between the fore-finger and thumb of one hand and pinching the skin around the anus with the other hand. Then pull. To eat them raw, bite the body off close to the head. Lindsay says the best way to cook them is to toss them into hot ashes and gut them after they are cooked. Other connoisseurs recommend them fried.

Lindsay is also enthusiastic about the larvae of ants. To get them, you smash open old stumps in which ants are nesting or you roll over stones. To separate them from dirt, throw them on water. The dirt sinks and the larvae float. Eat raw or toast on a hot stone.

Among the gastronomic delights of the Aborigines were march flies, wombats, bandicoots and possums. They either dug the wombats out of their burrows or smoked them out. They used lawyer vine to prod bandicoots out of dead logs and hunted possums by night. In some areas they trapped emus in pits camouflaged with vegetation. They trapped water birds and parrots as they came to drink. They ate all kinds of birds' eggs and various kinds of frogs. The kind to avoid today is the poisonous introduced cane toad. Baked snake was a popular dish, as it is in many countries today. Lindsay says the best places to look for snakes are beside logs, heaps of stones or loose boulders and the best times are the warm part of the day in cooler weather and either early morning or late afternoon in hot weather. If you use a stick to kill a snake, make sure it is a green one. Dead sticks crack. Even venomous snakes are safe to eat, provided you cut off the head, for the poison is in glands in that region.

Remember: Animal food will give you the most food value per kilogram and many insects have a high fat content. If the

survivor has a choice, he should avoid eating animal foods (proteins) if water is scarce. The protein breaks down to urea in the body, and this requires water so that it can be excreted as urine.

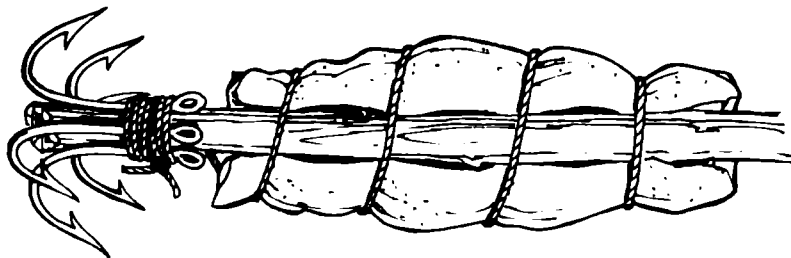
Fish tucker

Water is also the source of food. One of the most popular meals is the freshwater crayfish (yabby) which many children catch in streams and ponds by attaching a piece of meat to a piece of string and waiting for the crayfish to take the bait. It can sometimes be pulled from the water while still clutching the bait, but it is safer to use some kind of scoop or net.

Edible marine shellfish include oysters, scallops, abalone, cockles and mussels. Simply boil for about 10 minutes, then bite. Squid and cuttlefish are also edible after being boiled or fried. Squid are easily caught with a 'squid jag'—a straight stick with a few hooks at one end, a piece of fish attached to the stick, and a line to jog the jag. Give a quick tug as the tentacles are wrapped around the bait. Watch out for cone shellfish, which are venomous (see Chapter 8).

Shrimps—a number of species which resemble the marine prawn—may be caught in lakes or creeks with a small net or a billycan with a bone or scrap of meat inside it. Attach a line to the container and remove the billycan from the water every half hour or so.

The United States Air Force gives this advice to its men: 'Never risk your life with questionable sea food. Never eat



Squid jag

fish with slimy gills, sunken eyes, flabby flesh or skin, or an unpleasant odour. If the flesh remains dented when you press your thumb against it, the fish is probably stale.' For more advice on dangerous fish see Chapter 8.

Hunting

No survival handbook will make an expert hunter out of an inexperienced person, but the hunting hints that follow may be generally useful.

To catch warm-blooded, hairy animals requires skill and patience. A beginner should use 'still hunting'. Hide downwind from an animal trail, watering place or feeding ground. Stay still until the animal is feeding or looking the other way. Freeze when he looks your way.

The best place to find game is near water. The best time is early morning or dusk. Look for tracks, trampled undergrowth or droppings.

Some animals live in holes in the ground or in hollow trees. Poke a flexible stick in a hole to see if it is inhabited. Close off all exits but one and poke the animal out of his hiding place or smoke him out. Club him as he emerges. Clubs and sharp sticks are useful weapons for this kind of work.

H. A. Lindsay warns that throwing stones at small game is a waste of time. He recommends cutting sticks of tough, heavy wood about 450 mm long by 25 mm thick. They should have a slight bend in them and be about the same weight. Throw with a quick swing of the arm and a flick of the wrist. Make the stick spin as it leaves the hand. As it spins it will cover a circle of about half a metre and give you a better chance of hitting your quarry than you would have with a stone. Use it on rabbits, hares, wallabies and birds.

He also has some advice on hitting wild duck, 'one of the most difficult of all feats'. Hide where a creek is heavily timbered on both sides so that there is only a narrow opening for the birds to pass through. Have your throwing sticks prepared and also make a small boomerang. When the ducks are close hurl the boomerang straight up and whistle shrilly.



The ducks bunch, fly down and skim the water near you. Throw your sticks, aiming at least 7 metres ahead of them. 'Your surprise at the way in which that stick usually seems to pass right through the flock without touching a duck is only exceeded by the amazement which you feel if there is a splash and you see a duck floating on the water'. Lindsay writes.

Snares

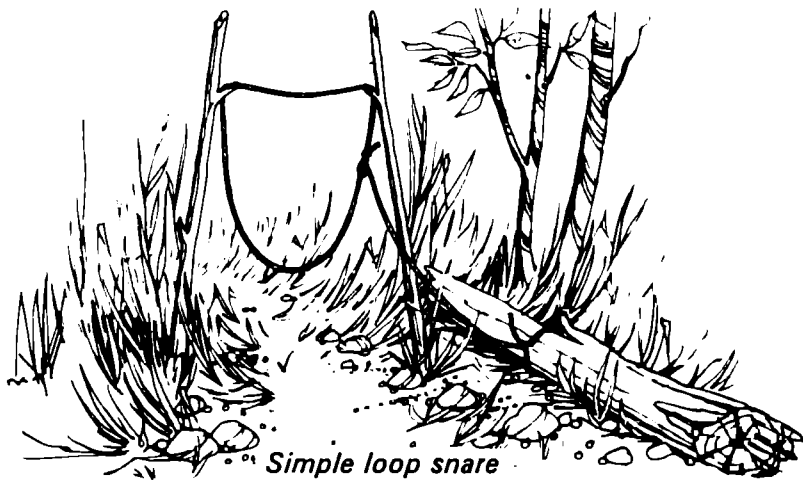
Most survival manuals contain sketches of a variety of animal snares and advice on how to use them. Lindsay claims to have tried them all and to have found only four useful. He sneers at devices which shoot arrows from bows, sling spears from bent limbs, and use stake pits. 'I am quite sure', he says, 'that many of them would never work unless you could first teach the game to read and then put up a notice beside each trap, requesting the animal to kindly insert its head at the spot marked X.'

The four snares he recommends may be equally as daunting to the novice. They are the simple loop, the spring-up, the trigger-plate and the deadfall.

To set a snare, find a pad on which animals travel regularly, then find a place between two trees, two bushes or two rocks to set up your snare. Arrange pickets, bushes or obstacles in such a way as to make the animal pass through the snare.

Simple loop

The simple loop is a running noose made in light, fine wire or thin cord and large enough for the animal to slip his head into, but not so large as to allow his body to go through. The loop will be set at the right height for rabbits if it is as high as your fist with thumb held upright. For hares, the height is two fists and a thumb. For wallabies, about knee-high. Hold the loop steady with two small sticks with split ends, but don't fasten the free end of the wire to a peg, unless you are setting it in open grassland. Tie it to the centre of a stout green stick about half a metre long laid parallel to the track. The animal will drag the stick until the stick is caught in bracken or rocks and by then

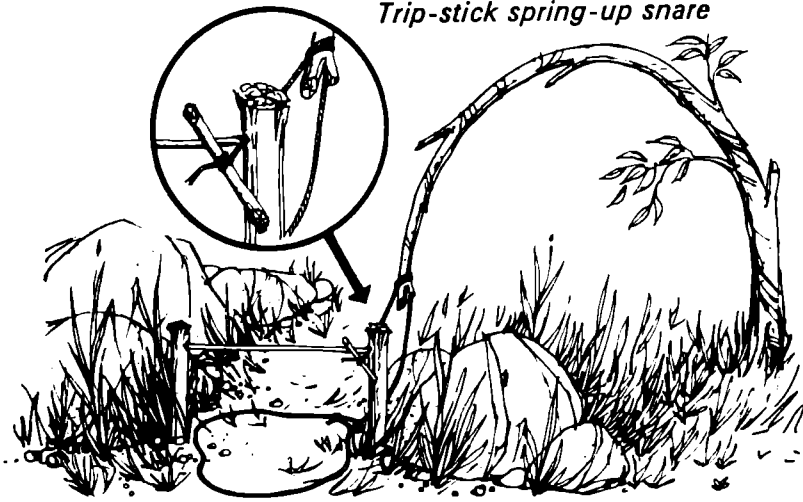


it is strangling. In open grassland you must tie the free end to a peg. Your snare wires may break, but it is no good using heavy wire as the noose won't run properly.

Spring-up

A spring-up snare is made of a noose attached to a sapling. It jerks the animal into the air, and keeps him out of reach of other animals. To make a spring-up snare, drive two pegs firmly into the ground on either side of the animal pad. Cut a notch in the side of each at about the height of the chest of the animal you wish to catch. Cut a thin stiff stick long enough to fit between the two pegs. Trim its ends to chisel points. Fit it into the notches on the pegs to form a trip-stick. Dig a hole about half a metre deep about 2 metres from one of the pegs and in line with them. Get a long, thin, flexible sapling, tie a snare loop to the top and a short piece of cord with a 50 mm toggle on the free end. Place the sapling in the hole. Bend it so that the top is beside the nearer peg. Place the toggle under the trip-stick and across it and the peg. Release your grip on the sapling slowly and keep your head out of the way in case the toggle trigger slips. If it doesn't, spread your noose on the pad to catch a leg of the animal.

Trip-stick spring-up snare



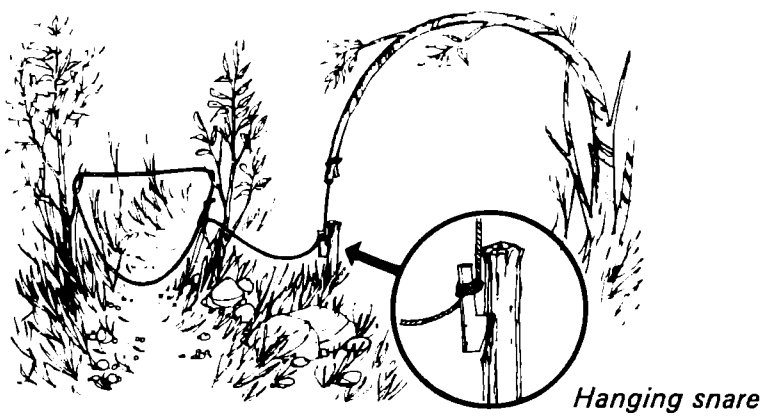
The device is supposed to work when the animal touches the trip-stick across the track, knocks the free end out of its notch, and thus releases the toggle-trigger at the other end, so that the sapling flies up, the noose closes on the leg of the animal, and he is whipped into the air. H. A. Lindsay recommends that you camouflage the trip-stick with some bush creeper and place a bough above the snare and across the track so that the animal won't try to jump over the stick but will duck its head to pass under the bough.

Trigger-plate

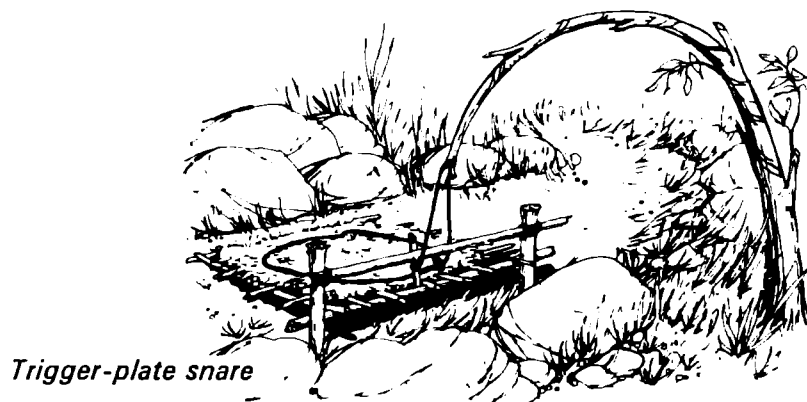
The trigger-plate snare is a variant of the trip-stick. It has a frame of cane or thin sticks in place of the trip-stick. The animal releases the toggle when it treads on the frame, which is placed across the track and covered with leaves or bushes.

Deadfall

A simple deadfall consists of a stone or a heavy log with one end balanced on a short stick to which a string is tied. Bait is placed under the raised end of the stone and the string pulled when a bird takes the bait.



Hanging snare



Trigger-plate snare



Simple deadfall

Bait

The survivor will have to make do with whatever bait is available. Richard Graves, who was concerned more with bushcraft than survival, says that broadly there are four different divisions of animal feeding patterns: tree-feeding animals, earth-digging and feeding animals, flesh-eating animals and grazing animals. He says baits for tree-feeding animals must be fruits; for earth-digging animals they must be roots or insects; for flesh eaters they must be flesh, and for grazing animals they must be herbage. He recommends test baiting to find out what kinds of animals inhabit an area and suggests these test baits for Australian conditions:

Roots:

- sweet potato
- carrot
- parsnip
- dandelion root
- yam or other ground tuber

Seeds and grains:

- pumpkin seed
- melon seed
- corn
- wheat
- sorghum seed
- peanut
- nut

Flesh:

- meat
- fish head
- worm
- cheese

Fruits:

- apple
- banana
- fig and local fruit baits

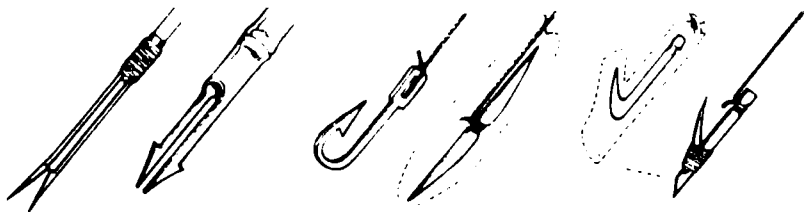
Herbage:

- cabbage leaf
- lettuce leaf
- celery stalk
- carrot top

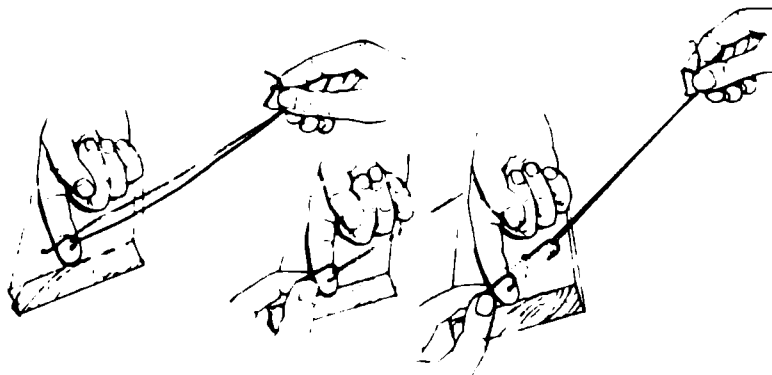
These should be used both with and without lures.

Fishing

If the survivor is on the coast, on the sea, or near inland water, the easiest way to get food may be to fish. The simplest, but not necessarily the most efficient, way to catch fish is with a hook and line. Hooks may be improvised from wire or pins; short lines may be made from shoe laces. A length of wire between the line and the hook will prevent a fish from biting the line in two. Use insects, shellfish, worms or meat for bait, or better still, see what the fish are eating.



Improvised fish hooks and spears



This almost painless method of removing a fish hook from someone's finger makes the hook retrace its passage through the flesh by applying forces which make it go into reverse along its pathway. Loop a piece of string about 1000 mm long double and wrap the ends around your index finger. Drop the loop, 450 mm long, over the shank of the hook. The victim rests his finger on a firm surface, with the eye of the hook pointing to your left (if you are right-handed; reverse all the directions given if you are left-handed). Grasp the eye and shank of the hook between your left thumb and index finger and press it down. This disengages the barb. With your right hand pull the loop of string out in a parallel direction to the shank. This brings the loop to the centre of the curve of the hook, where you can hold it with the tip of a left-hand finger. Pull smartly with the right hand. This will remove the hook painlessly without enlarging the track or hole.

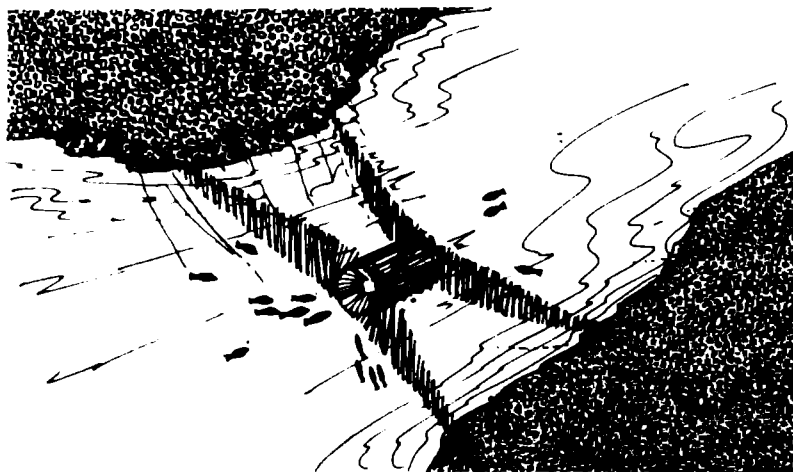
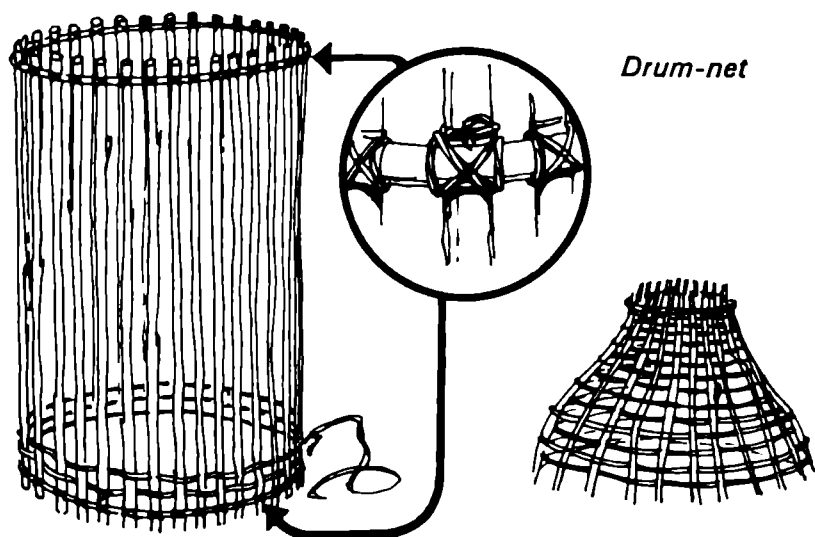
In fresh water, try fishing in the deepest parts first. In shallow water fish first in pools below falls, at the foot of rapids, or behind rocks. The best times are usually early morning or late evening. If you have a light to attract fish, fishing at night may yield a catch. Always fish with the outgoing or low tide. Keep off slippery rocks. Keep out of the surf.

A hook and line is a comparatively inefficient way to catch fish. A better way is with a net. If you have one, or can make one, you will catch more fish more quickly.

H. A. Lindsay describes how to make a drum-net. It may be made from a framework of wood or iron covered with wire netting or it may be woven from split bamboo, lawyer cane, supplejack canes, willow wands or any thin and pliant sticks. It may be one or two metres long and up to a metre in diameter. One or both ends should be fitted with funnels which taper to a small opening. The bait is placed in a netting basket in the centre of the trap and the trap itself is set in a stream with an opening pointing downstream. Meat, mussels, crushed yabbies or a wad of cotton wool in which dough has been mixed will make good bait. When the trap is set in a stream it should be placed in a quiet, deep part under a bank, or just inside the mouth of a backwater off the main stream. When set in the sea it should be placed on the sea-bed in the lee of a reef, or weighted with stones and sunk in a channel, with a buoy attached.

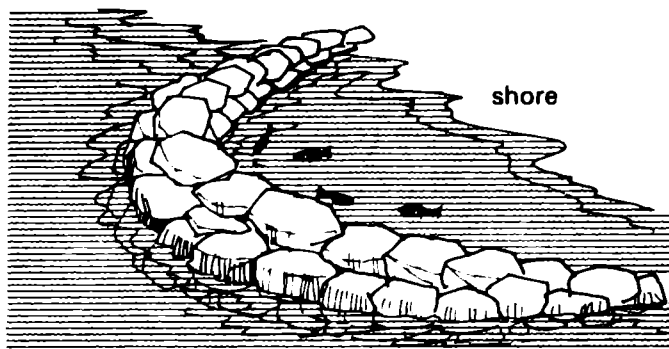
To weave your drum-net, cut a bundle of green canes or sticks, about 12 mm in diameter and slightly longer than you want your trap to be. Mark out a circle in sand to correspond to the end of your trap. Drive in a peg every 50 mm around the circle to make holes, ensuring that you have an even number of holes. Stand one of your canes in each hole. Take some thin, pliant cane or long twigs and make two rings, twisted like a rope, of the same size as the inside of the trap. Lash one ring to the top of the canes to hold the uprights in position and drop the other inside to serve as a gauge. It is moved upward as you weave to ensure that the diameter is consistent. For weaving material use thin, pliant cane or branches. Begin weaving in and out around the base of the trap, continuing at spaces of 50 mm to the top. Lift the trap out of the ground and lash the gauge ring to the bottom end. The funnels may be made by standing a 125 mm diameter post in the centre of the original circle. Place lengths of cane, about one-third of the length of the trap, into the holes. Bend their tops upward and lash them to the post. Lash the ends

together. Remove the post. Lash one funnel into one end of the trap, but provide the other with a stiffening ring at the larger end and fasten it with a few lashings as it has to be removed to empty the trap.

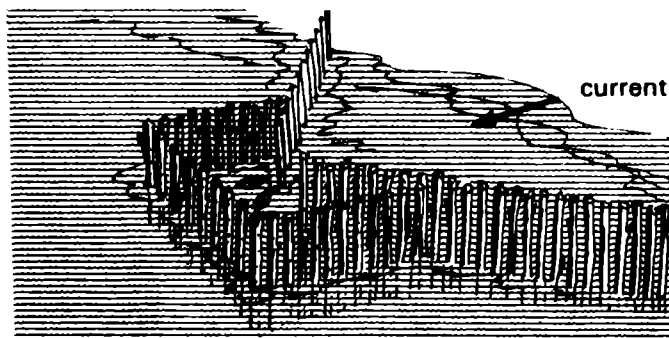


Set your drum-net in the mouth of a backwater

The U.S. Air Force recommends fish traps or weirs for catching both fresh and salt water fish, especially those that swim in schools. In lakes or large streams, it says, fish tend to approach the banks and shallows in the morning and evening. Sea fish, moving in schools, tend to approach the shore with the incoming tide. To catch them, build a fish trap by making an enclosure with a blind opening where two fence-like walls extend out, like a funnel, from the entrance. Pick the site for the trap at high tide; build at low tide. Try to choose a site where natural features will reduce your work; for example use sand bars or natural rock pools or natural coral pools on the surface of reefs by blocking openings as the tide recedes.



Tidal flat fish trap



Maze-type fish trap

You can make a brush weir in protected bays or inlets, using the narrowest area and extending one arm towards the shore. Place nets across the mouths of streams or at right angles to shore.

Set stakes or brush into the bottom of a small, shallow stream or weight them down with stones so that the stream is almost blocked, but leave a small, narrow opening into your stone or brush pen in shallow water. Wade into the stream and herd the fish into your trap.

H. A. Lindsay recommends the Aboriginal method for catching small native fish in clear pools. Select two hard round stones about the size of a cricket ball. Take one in each hand, step into the pool, gently shepherd the fish to one end, quietly move to within about a metre of them, then sharply crack the stones together under water. He says fish within a radius of 1.2 metres will come to the surface, stunned by the concussion. Place your hands under them and toss them ashore.

Plants

When he wrote *The bushman's handbook* in the 1940s Lindsay lamented that no one had written a handbook on the edible native plants of southern Australia. That gap has now been filled. Two botanists, A. B. and J. W. Cribb, have produced *Wild food in Australia* (Collins, Sydney, 1975), a book mainly about food plants available in Australia.

There are said to be more than 300 000 different kinds of wild plants in the world. Thousands of them occur in Australia. Hundreds of them were eaten by the Australian Aborigines. The Cribbs themselves say they have eaten about two hundred. In their readable little book they describe several hundred, classifying them into fruits; seeds; leaves and shoots; roots, tubers and bulbs; flowers; water sources and beverages; exudates; algae; and fungi.

It would be impossible to summarise here what the Cribbs summarise in 240 pages, so what follows is only an impressionistic survey of some of the plant food they discuss in some detail in their book.

Fruits

The Cribbs say that Australian fruits are still at the 'crab-apple' stage of development, but among those which come with some recommendations are :

Austromyrtus dulcis grows on a small, spreading shrub in sandy coastal country in New South Wales and Queensland. The fruit is pale lilac to white in colour, has a soft pulp and mildly aromatic flavour.

Buchanania arborescens, or little gooseberry tree, grows in Queensland and Northern Territory. It has alternate leathery leaves, sprays of white flowers, and purple fruits about 10 mm broad.

Capparis, or native caper, caper bush, or native pomegranate, comes in about twenty species in Australia and occurs in all States except Victoria and Tasmania. Some are small trees, some shrubs, and some scrambling climbers. Some species have fruits up to 70 mm across. At maturity they are generally orange-yellow.

Citrus limon, or bush lemon, grows in Queensland and New South Wales and looks something like a knobbly domestic lemon.

Cocos nucifera, or coconut, grows in Queensland and Northern Territory and is one of the best known tropical fruits. It grows mostly near the seashore. The U.S. Air Force gives some useful advice about how a survivor can get the most out of a coconut palm.

What to eat. Cabbage : the cabbage or growing heart is an excellent vegetable cooked or raw.

Nuts : all or part of the husk of the young nut may be sweet ; if so, chew it like cane. Drink the milk from the nut. You may get over a litre of cold fluid from one young nut, especially at the jelly stage, when the flesh is soft. A ripe nut will gurgle when shaken near your ear. But do not drink from very young or old nuts.

Grate or chop up the meat or flesh as it firms up ; this makes it easier to digest.

Fallen nuts germinate where they lie. In these, both milk and meat are used up, but the cavity is filled with a spongy mass, called the bread. Eat this raw or toasted in a shell over the fire. It tastes good and is very sustaining. Eat the sprouts like celery.

Climbing the coconut palm. Coconuts grow in clusters near the top of the palm. The slim and slippery trunks are very difficult to climb. You may want to use a climbing bandage—a belt or rope a little longer than the circumference of the tree. Put it around the trunk, leaving enough room for your feet, and step on it with both feet. The loop on the other side of the trunk will support your weight. Reach up with your arms and grasp the trunk with both hands. Pull yourself on, doubling your knees and sliding the bandage up to a higher position with your feet. Straighten up, resting your weight on the bandage to get a new position. Repeat the process and you can climb to any height.

Husking coconuts. The nut is encased in a husk consisting of a smooth exterior and a matting of tough fibres. If you have a heavy knife or an axe, you need not remove the husk of the green coconut to get the liquid. Whittle off the husk at the free (not the stem) end to a crude point and then cut off the end and the top of the nut inside.

If you haven't a knife or a machete, use this procedure: Drive a stake 900–1200 mm long into the ground so that it slants away at a right angle. The top of the stake should be given a crude wedge-shaped edge so that it will pierce the longitudinal fibres of the husk. Stand about 300 mm clear of the stake, judging the point of entry so that the stake will clear the nut within the husk. Then push the coconut downward firmly against the sharpened stake with your hands, giving the coconut a twisting motion to pry off a small portion of the husk. By repeating this process you can remove the entire husk from either green or mature nuts.

Once the nut is out of the husk, your problem is to break through the hard shell. To open a nut, hold it in one hand so that the eyes (at the stem end) are uppermost. Strike it sharply with a stone or with the point of a mature nut, just below each

eye. The shell will crack and the top of the nut can be picked off without spilling the liquid. Poke out the eyes of a mature nut and drink the liquid. To break it open, place it on its side on the palm of your hand. In your other hand, grasp a stone and strike the middle of the nut, revolving it a quarter turn and striking it again. Continue to turn it, striking it each time, until it cracks in half.

Coprosma pumila is a fruit of alpine regions, as are *Leucopogon montanus* or snow beard-heath and *Pentachondra pumila* or carpet heath.

Davidsonia pruriens, or ooray, Davidson's plum, is recommended by the Cribbs as one of the best native fruits they know. It occurs in Queensland, grows on a small tree in tropical rain forests, is blue-black and plum-like, has a few loose hairs on the surface and a soft, juicy purple flesh. It has an acid taste. The Cribbs prefer it stewed or made into jam or jelly.

Enchylaena tomentosa, or Barrier saltbush, ruby saltbush, occurs in all States and is common on inland plains. Aborigines used to eat its red, berry-like fruits.

Eugenia smithii, or lillypilly, is a large genus of trees and shrubs occurring in eastern Australia, mainly in rain forests. Its fruits have cream, purple, pink or red smooth skin and vary from 10 mm to 60 mm in diameter.

Exocarpos cupressiformis, or native cherry, is a small tree of eucalypt forests.

Ficus, or figs, come in many varieties, most of them in northern rain forests, and include such well-known ones as the Moreton Bay fig. The fruits vary in size and are best eaten when soft and pulpy.

In central Australia can be found *Ficus platypoda* var. *minor* or native fig, a large spreading shrub or small tree to 3 metres high and up to 7 metres in diameter with glossy green leaves. It is only found in hilly country, usually in gorges or other sheltered areas. The small somewhat tart fruit are best

eaten when they turn pink. In an emergency the fallen dried fruit can be collected from under the shrub and ground into an edible paste with a little water.

Leichhardtia australis or native banana is a vine with somewhat tough leaves, small clusters of inconspicuous flowers and white milky sap. Usually twining up shrubs or dead tree trunks, it can be rather inconspicuous until the characteristic fruits are formed. It grows sparsely over most of central Australia. The immature fruits can be eaten whole, either raw or cooked, but when the fruit matures only the outer skin is edible. The leaves and flowers can also be eaten in an emergency.

Linospadix monostachyus, or walking-stick palm, occurs in New South Wales and Queensland and is the tree whose fruits helped sustain two survivors of a Stinson plane crash in the Lamington National Park in Queensland in 1937 before they were found by Bernard O'Reilly eleven days after the crash. The palm's stem is slender enough to be used as a walking stick and the root-mass at the base can be trimmed to form the knob. The fruit is up to 10 mm broad and is edible when red.

Mangifera indica, or mango, is a popular tropical fruit found in Queensland.

Musa banksii, or native banana, grows in north Queensland rain forests and closely resembles the cultivated banana, although its fruit is more slender.

Opuntia, or prickly pear, is a pest which occurs in eastern States but is nevertheless edible. Its thick green pads bear large spines and short bristles which can irritate the skin. The purplish-red, pear-shaped fruits are 40–50 mm long. They must be handled carefully and peeled before eating as they bear bristles similar to those on the pads. One way to remove them is to singe them off.

Persoonia, or geebung, species are found in all States.

Rubus, or native raspberries, occur in eastern States and bear edible red fruit resembling cultivated raspberries.

Rubus fruticosus, or blackberry, bramble, is a pest on some parts of the coast. The fruit is a glossy purple-black and may be found in the eastern States.

Santalum acuminatum, or quandong, occurs in all mainland States. Its round, pendulous fruits are 20–30 mm across and are red when ripe. It is ripe when it falls to the ground or if it rattles when shaken. The round, pitted stones were used as a substitute for marbles in games of Chinese checkers in World War II and children sometimes play 'conkers' or 'bullies' with them.

Solanum aviculare, or kangaroo apple, is a soft-wooded shrub of rain forest margins.

Solanum centrale or desert raisin is a shrub with purple flowers which grows to 400 mm high. The leaves are covered with a mat of hairs and the youngest leaves are often rusty brown. It is found, usually growing in clusters, in red sand in porcupine grass country. The immature green fruits are inedible but can be eaten when they turn yellow or dry to a chocolate brown colour. It can be distinguished from other *Solanums* by the sticky fruit to which sand-grains will adhere and by the raisin-like texture of the dry fruit. Overeating of the fruits may cause diarrhoea. Similar plants without the desert raisin's characteristic fruit should be avoided as they could be poisonous.

Seeds

The Cribbs say that the amount of food in different seeds varies. Seeds which contain large reserves are frequently used by man as food. They warn that some seeds liberate prussic acid or bitter ingredients, which make them inedible.

Acacia, or wattle, fruits and seeds from the more than 300 species in Australia are in many cases inedible but Aborigines ate the roasted pods of prickly Moses, which grows along inland watercourses, and the seeds of the mulga tree (*Acacia aneura*), and the pods of the boobyalla.

Avicennia marina var. *australasica*, or grey mangrove, occurs in all mainland States. Its green velvety fruits are about 30 mm broad and each contains one seed. They should be eaten after boiling for 20 minutes in three changes of water.

Brachychiton populneus, or kurrajong, carry seeds in their hard, leathery mature fruit, which splits open. Rub the seeds between two boards to rid them of their irritating hairs and eat raw or roasted.

Endiandra palmerstonii, or Queensland walnut, is one of Queensland's largest and best known trees. The Aborigines ate its red fruits after roasting them, pounding them, and immersing them in running water.

Macadamia, or Queensland nut, bauple nut, macadamia nut, is found in Queensland and is the only endemic Australian plant grown commercially as a food plant. The shiny seeds may be seen when the leathery fruit wall splits at maturity. The nuts should not be cracked until several weeks later. If the bony outer coat of the nut has split naturally, don't eat the kernels, because they may be poisonous on germination.

Santalum acuminatum, or quandong, has already been mentioned under Fruits. Its oily seed is also edible.

Portulaca oleracea (munyeroo, pigweed, purslane) is a somewhat fleshy ground-hugging herb with yellow flowers found throughout Australia. As it gets older the leaves are shed and the pinkish stems are exposed. This plant is widespread in central Australia but most commonly found in disturbed areas where the soils are good, i.e. on the banks and levees of watercourses. The whole plant can be eaten raw, boiled or steamed. The small jet-black seeds are also edible. To obtain these seeds mature plants should be piled onto a clean surface and as the plant dries the seeds will fall onto the surface where they can be readily gathered and ground into a flour-like paste.

The Cribbs say that the seeds of all native grasses may be regarded as safe to eat. Among those they describe are Mitchell grass, wild rice and Australian millet.

Leaves and shoots

In choosing Australian native plants for salads or for cooking as vegetables use only young leaves and shoots. Those which are cooked should be cooked in the same way as spinach.

Atriplex cinerea, or grey saltbush, grows near the coast in all States as a bush up to 1.5 m high. It may be cooked as a green vegetable. Some other saltbushes may also be used as spinach substitute.

Brachychiton rupestris, or bottle-tree, grows in Queensland and its shoots may be cooked and eaten.

Ficus, or fig, provides young shoots which may be eaten as a boiled green vegetable.

Hibiscus, in many of its species, may be eaten cooked or raw. The Aborigines are said to have eaten both leaves and flower buds.

Opuntia, or prickly pear, provides a vegetable when the young, tender joints of the stem are boiled.

Palms. Many palms provide good vegetable. The palm heart, or cabbage, normally hidden in leaves at the top of the tree, may be boiled or roasted in the ashes. Removal of the apical bud kills the tree, however. The cabbage-palm, picca-been palm and walking-stick palm have all been praised for their cabbages.

Pisonia grandis, or pisonia, is the dominant tree on many coral cays off the Queensland coast. Young leaves make an edible cooked vegetable.

Among climbers and scramblers which can be used as vegetables is supplejack (boil the young shoots) and among herbs and grasses are chaff-flower (boil young leaves), green amaranth (boil young leaves), austral winter-cress (as a green salad), cobbler's pegs (boil young leaves), fat-hen (a spinach substitute), potato weed (boil whole plant), watercress (leaves as salad or as boiled green vegetable), the giant water-lily (peel skin from stalks and eat raw), pigweed (boil leafy shoots), milk thistle (boil leaves and shoots), and dandelion (eat young leaves raw or cooked).

Roots, tubers and bulbs

Roots of young kurrajongs and bottle-trees have been eaten ; so has the bark from the young roots of gum-trees. The roots of some species of *Hibiscus* have also been eaten.

One of the best known edible tubers is the yam, the starchy subterranean tuber of *Dioscorea*. Yams are tropical plants found in Queensland, New South Wales and the Northern Territory. Some may be eaten raw, but as some contain poison, it is a good rule to cook them all. The Ab-origines sliced them and soaked them in running water for several hours. Then they may be boiled, baked or steamed.

Another is taro, a tropical plant resembling the arum lily and rich in starch. Its tuberous underground stem must be boiled or baked after cleaning.

A root found on coastal sand dunes is *Ipomoea pes-caprae* or goatsfoot convulvulus, and one found in alpine areas is *Microseris lanceolata* or yam daisy or native dandelion.

Two water plants are *Crinum flaccidum* or Darling (or other river) lily, found on the flood plains of rivers, which has a large underground bulb containing arrowroot, and *Triglochin procera* or water-ribbon, which has swollen roots.

Algae

Algae comprise the seaweeds, the green slimes of fresh water, and a few other plants. The Cribbs say that few are tasty when eaten raw but many could probably be used chopped in salads or stews. Of those they discuss, they show enthusiasm for only two.

Nostoc commune are mainly freshwater algae forming olive-green, gelatinous colonies, some of about the size of a grain of cooked sago. To a hungry man, say the Cribbs, it would probably be welcome raw.

Porphyra, or laver, forms delicate, purplish, membranous sheets on rocky shores. It should be washed, then soaked in fresh water for a couple of hours. The sheets may be lightly boiled, or fried, or fried with oatmeal.

Persoonia pinifolia
geebung
National Botanic Gardens



Ipomoea pes-caprae
goatsfoot convulvulus
National Botanic Gardens



Austromyrtus dulcis (p. 52)





Exocarpos cupressiformis
native cherry
National Botanic Gardens



Solanum aviculare
kangaroo apple
National Botanic Gardens



Brachychiton rupestris
bottle-tree (p. 58)



Brachychiton populneus
kurrajong (p. 57)



Eugenia smithii
lillypilly
National Botanic Gardens



Rubus rosifolius
native raspberry
National Botanic Gardens



Avicennia marina
grey mangrove (p. 57)



Acacia aneura
mulga tree (p. 56)



Leucopogon montanus
snow beard-heath
Colin Totterdell

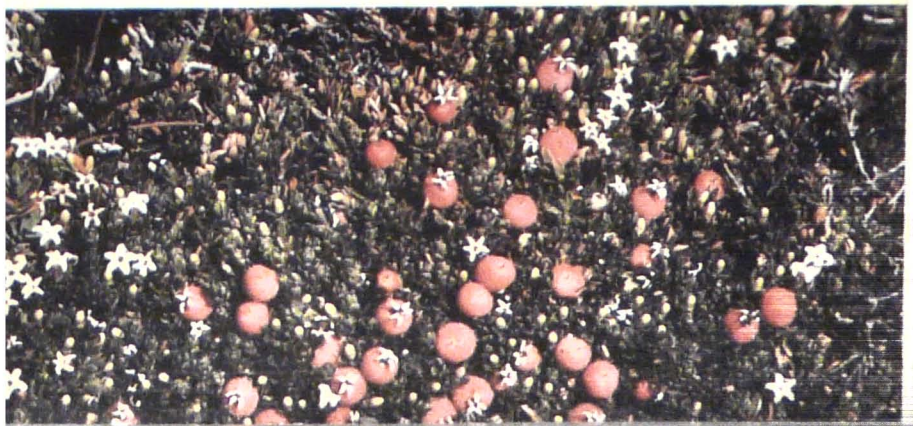
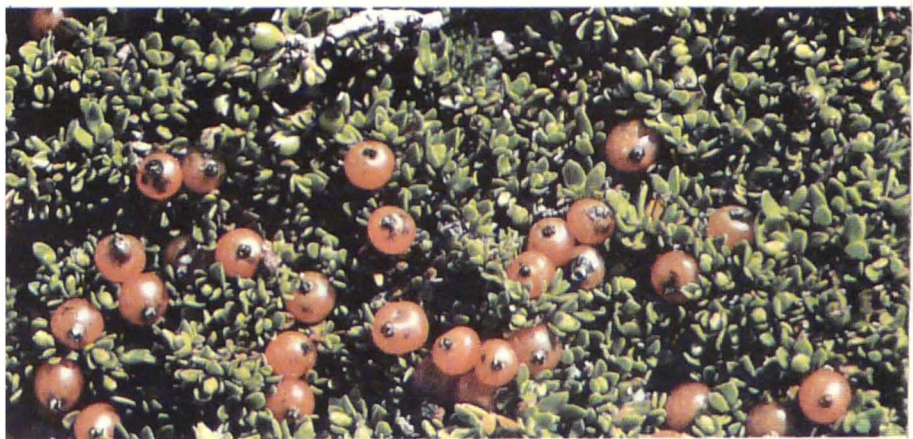


Coprosma pumila
Colin Totterdell



Pentachondra pumila
carpet heath
Colin Totterdell





Crinum flaccidum
 Darling lily
 National Botanic Gardens



(left) *Triglochin procera*
 water-ribbon
 National Botanic Gardens



(right) *Microseris lanceolata*
 yam daisy or native dandelion
 Colin Totterdell





Santalum acuminatum
quandong
National Botanic Gardens



Enchylaena tomentosa
Barrier saltbush
National Botanic Gardens



Ficus platypoda
native fig
P. K. Latz





Leichhardtia australis
 native banana
 P. K. Latz



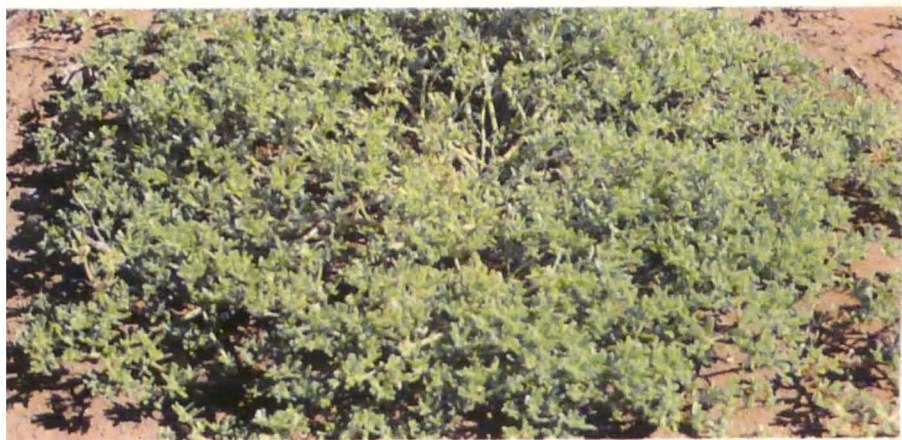
May now be
 called *Marsdenia australis* - s. l. by pear/Karkula

Portulaca oleracea
 pigweed
 P. K. Latz



Solanum centrale
 desert raisin
 P. K. Latz







Fistulina hepatica
beefsteak fungus

Colin Totterdell



Calvatia lilacina
puffball



Ramaria formosa coral fungus
Agaricus arvensis field mushroom

Colin Totterdell



Colin Totterdell

Fungi

The U.S. Air Force survival manual says flatly that 98 per cent of the several hundred kinds of wild mushrooms (including most of the so-called toadstools) are edible. The Cribbs are more cautious. While admitting that there is a widespread popular prejudice against fungi, they warn that in Australia knowledge of the edibility of fungi is fragmentary and only a few of the hundreds of gilled fungi are known to be edible. They also say that there are no simple tests which will help to distinguish the poisonous varieties. Some gilled fungi are among the world's most toxic plants and eating them can cause death.

Dr C. J. Shepherd of the CSIRO Division of Plant Industry gives four basic rules:

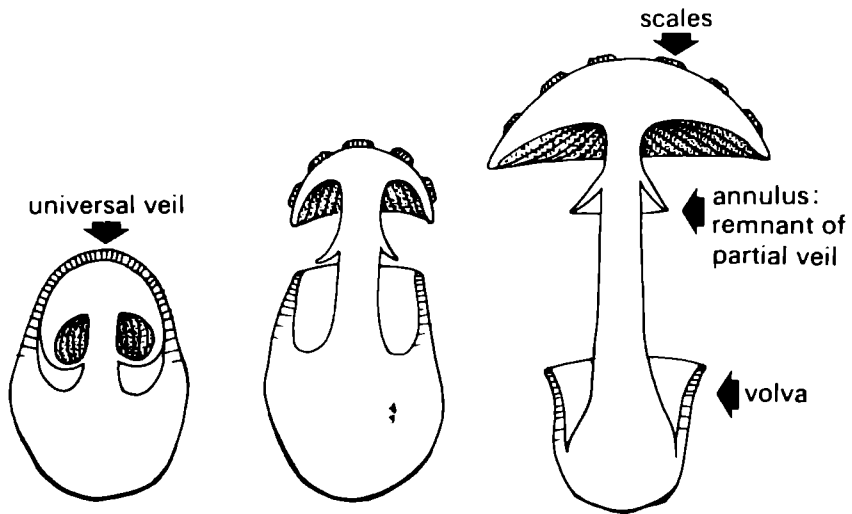
- Avoid rings and cups together (see illustration).
- If they have rings, only eat those with pink to brown gills.
- Don't eat those with red on them anywhere at all.
- Don't eat those which go blue if they are bruised.

The best known wild mushroom in Australia is the field mushroom, which grows up to 100 mm high. The cap is usually white and silky. There is a ring on the stalk when the mushroom is young but it may disappear at maturity. The immature gills are bright pink but change to chocolate and then a brownish purple when mature. Don't use mushrooms which have started to decay or have been attacked by insects.

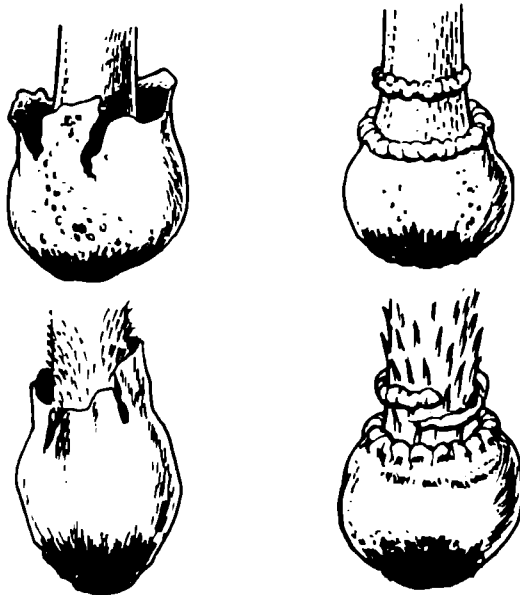
The Cribbs recommend puffballs, which are white to brownish in colour. They may be eaten while the interior is white. As the puffball matures the interior turns yellowish and then brown and powdery. The ordinary puffball is 25–37 mm high, while the giant puffball can grow to 100 mm.

Among other edible fungi are *Ramaria formosa* or coral fungus, which grows in clumps 50–75 mm high, and *Fistulina hepatica* or beefsteak, about the size of a teacup.

Among the mushrooms to avoid are the iodoform mushroom which, like the horse mushroom, has a double ring and no pink gills, more obvious yellowish bruises on cap and stalk, a longer stalk and an odour like disinfectant. Another to



Mushroom development of ring and cup



Mushrooms with cups are always poisonous

avoid is the *Amanita* which has white gills and a cup at the base of the stalk. The *Macrolepiota dolichaulos* may also cause illness. It has a white cap and spores and an elongate white stalk with a prominent ring. It may grow up to 300 mm high. The gold top or hysteria toadstool should be avoided because it contains an hallucinogen. Although similar to the field mushroom, it has a relatively longer stalk and a yellowish stain on the cap. When young it lacks the pink gills of the field mushroom. Its gills are a dirty white. They become grey, then grey-black with a purple tinge.

Remember that colour is not a reliable guide to the edibility of mushrooms, nor can any reliance be placed on the belief that fungi are harmless if they peel, have a ring on the stem, fail to turn dark when left in salt water or fail to turn a silver coin black when cooking. Nor will cooking itself make a poisonous mushroom harmless. The best rule is when in doubt leave out: discard any mushroom you suspect of being poisonous.

Edibility

The U.S. Air Force offers some advice on the edibility of plants. The best way to familiarise yourself with the appearance of edible plants is to have someone point them out to you. Take every opportunity to learn about them. As a general rule, poisonous plants are not a serious hazard. Your greatest enemy under survival conditions will be the bacteria which may spoil and infect your food under makeshift sanitary conditions.

Another rule is never eat large quantities of a strange food without testing it. Cook some, take a mouthful, chew it, leave it in your mouth for about 5 minutes. If it still tastes good, eat it. Remember that olives are bitter and grape-fruit is sour, so an unpleasant taste doesn't necessarily mean poison. But a burning, nauseating or bitter taste may be a warning of danger. Mushrooms excepted, a small amount of poisonous food is not likely to prove fatal. A large amount may be. Again except for mushrooms, poisons are generally removed by cooking. Other general rules are avoid eating untested plants with

milky juice or letting the milk touch your skin (figs are among the exception to this rule) and avoid eating plants which are bitter.

Conserving food (and energy)

Remember these general rules also :

1. Try to estimate the number of days you expect to be on your own. Divide the available food into thirds. Allow two-thirds for the first half of your estimated time before rescue and one-third for the second half.
2. If you decide to divide your party, give each person travelling on for help about twice as much food as you give each person remaining at your survival camp. Thus those at the camp and those seeking help will stay in about the same physical condition for about the same length of time.
3. If you have less than a litre of water daily, avoid dry, starchy and highly flavoured foods and meat. Eating increases thirst. If water is available, the best foods to eat are those with high carbohydrate content, e.g. sugar, starches, cereals and fruit.
4. All work generates a need for more food and water. Do as little as possible.
5. You can live for many days without food if you have water. If you have plenty of water, drink more than normal.
6. Always be on the look-out for wild food.
7. Eat regularly, if possible, and eat well.
8. Cook your food, if possible.

Food preparation

Here are some hints on food preparation.

Skin large game. Bleed and gut all animals. Remove gall and urine bladders carefully so as not to taint meat.

Bleed and draw all birds. Skin the larger ones.

The best meat on a lizard is its hindquarters and tail. Eat

the legs of a frog. Turtles have flesh on legs, neck and tail and between their shells.

Skin all frogs and snakes. Discard skin, head and viscera.

Left in clean water overnight, clams, oysters, mussels, crabs and lobsters will clean themselves.

Bleed a fish as soon as you catch it by cutting out its gills and large blood vessels that lie near the backbone. Scale and wash it in clean water.

Cook all wild game, freshwater fish, mussels, snails and crayfish. Mince tough mussels. Stew parrots, hawks and crows to make them tender.

Boiling, roasting, baking and frying—in that order—are efficient ways of cooking. Succulent fruits are best boiled. Large, tough or heavy-skinned fruits are best baked or roasted. Boil greens, roots and tubers. Stew or fry mushrooms. Many nuts can be eaten raw but some are better roasted or ground into flour and made into cakes.

You can roast some food in the coals of a fire after coating it with mud. Fish and potato, for example, may be roasted in this way. There is no need to scale the fish. The skin will peel off with the baked clay when cooked.

You can also steam food with heated stones. Heat some stones in the fire, then allow the fire to burn down to coals. On some occasions stones have been known to explode when heated. Most bushmen warn against the use of stones taken from the beds of watercourses. Place such food as shellfish on and between the stones and cover with plant leaves, grass, seaweed and a layer of soil. When thoroughly steamed in their own juices, clams, oysters and mussels will show a gaping hole when uncovered and are ready for eating.

If you have a bowl, you can boil water and food in it by adding red-hot stones until the water boils. Cover for about an hour with big leaves, or until the food is well done.

Fire has five main uses in survival :

1. It keeps you warm.
2. It cooks your food.
3. It can help purify your water.
4. It can dry you, your clothes, equipment and food.
5. It can make a signal for help.

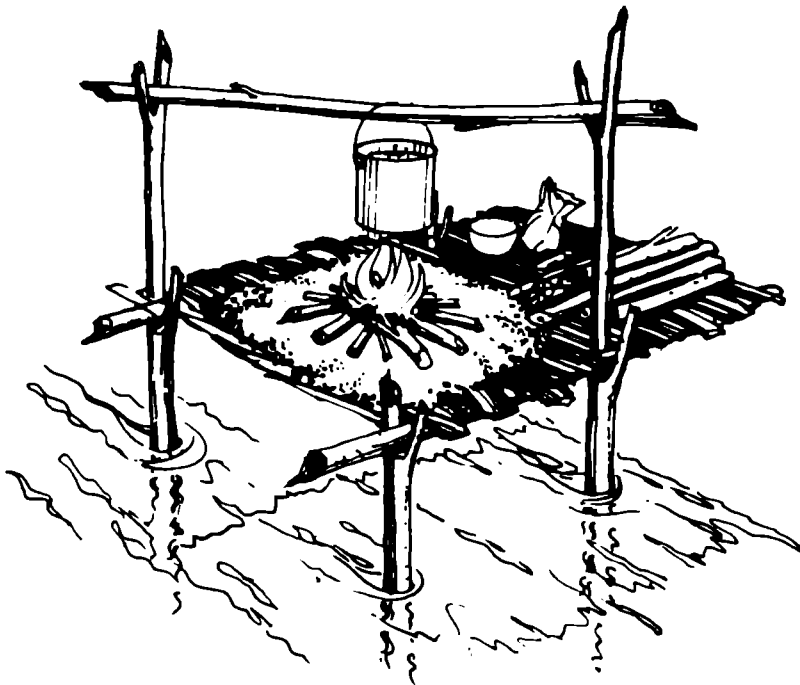
Fire may also improve your morale and even protect you from wild animals. Knowing where and how to light fires, knowing the kinds to build and the hazards associated with making them are among the most important survival skills.

Fireplaces

The best place to light a fire is on bare ground. Make sure that it is bare. Within a radius of one metre of your fireplace clear the earth of bushes, leaves, twigs, grass, moss and pine cones, otherwise you may be building not only a fire but a fire hazard. Indeed, bare earth itself may be a hazard if it is peaty earth because the peat may catch fire and smoulder for long periods, even when the fire seems to be out.

Other potentially hazardous places in which to light fires are under a tree or against a tree stump. The fire may dry out the tree and ignite the branches which in turn may start a 'top-fire', one of the most dreaded types of bushfire. A fire made under a snow-capped tree may melt the snow and the melting snow will put the fire out.

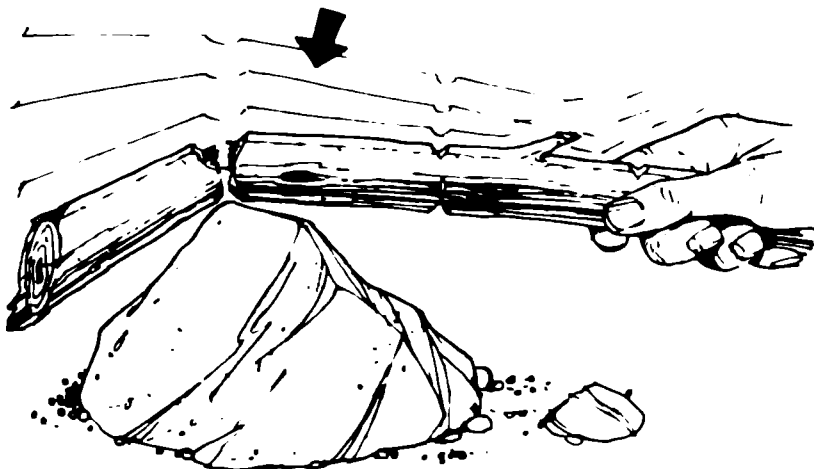
Good places to light fires are against rocks and boulders, on sand, and near the water's edge. In snow, marshland, water or wet ground, build your fire on a platform of rocks or green logs. A layer of mud on the logs is sometimes useful.



Fire in flooded areas

If the materials are available, fence the fire with stones or green logs. This is especially important with cooking fires as the stones or logs provide a platform for your cooking pot. To increase the usable heat from your fire use a reflector: either build your fire against rocks or make a log reflector on the windward side of your fire.

Remember that the best fires are not necessarily the biggest ones. The bigger they are the harder they are to tend. Big fires use more fuel, they are more difficult to extinguish, and they are a greater potential hazard than a small fire. The best cooking fire is a small fire, fuelled with small pieces of wood to provide quick heat. It need be no larger in diameter than the bottom of a frying pan or a camp oven. The most likely results of a big cooking fire are burnt food and burnt fingers.



Breaking wood

Firewood and kindling

The best firewood is dry standing dead wood and dead branches which have remained on trees. Wood found on the ground may be wet and difficult to light, although the inside of fallen tree trunks and branches may be dry even if the outside is wet. Wood gathered from ridges and high ground is generally better than that in gullies and swampy hollows.

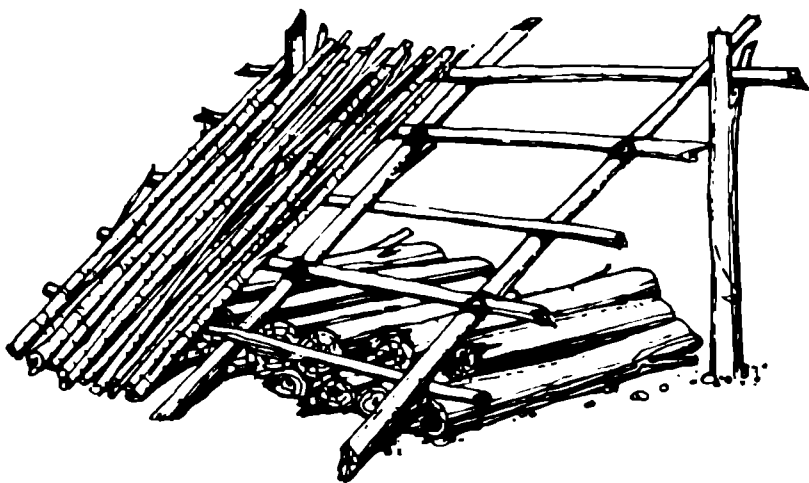
Much dead wood will split easily when pounded on a rock. It may also be broken by placing one end of a branch on a rock and stamping on the branch. If you have an axe, cut nicks on either side of the branch then bash the nick against a rock or log. If the axe wedges tightly in a block of wood, swing axe and wood into the air and strike the axe head against the ground with the wood uppermost.

Should you have a choice between softwood and hardwood, you will find the softwood easier to light. Pine, willow, oak and wattle are easy to cut and easy to ignite. They burn quickly and make a hot fire, ideal for boiling a billycan quickly, but they turn into ashes instead of embers. They also make good signal fires. Hardwoods, such as box or ironbark,

tend to burn more slowly and are ideal for campfires that have to last all night. They make good fires for roasting, broiling and baking and burn down to a bed of coals ideal for most cooking. If you have to use green wood, remember that it burns more easily when finely split.

There are two more things to remember about firewood. You will usually need more than you think you will and you should keep some under cover in case it rains. Cut or gather plenty of it and stack it near your fire. Keep some in your tent or shelter in case it rains. A fire which burns out in the middle of the night because of lack of fuel may be more than a nuisance. A simple woodshed may be made as shown in the diagram by driving two forked branches into the ground, dropping a crossrail into the forks and using this as the support for the roof poles and rough thatching. A shed which is a metre square on the ground and a metre high at the front should be adequate.

In treeless areas you will have to look for other natural fuels such as dry grass, which you can twist into bunches,



Woodshed

bushes, animal dung and animal fats. If you are the victim of a plane crash, you can burn either the fuel or lubricating oil or a mixture of both by lining the bottom of a can with 50 mm of sand, punching holes just above the level of the sand to allow air to enter, making slots at the top of the can to let flame and smoke out, then pouring the fuel on the sand. Protect your face and hands as much as possible when lighting it. A string, rope or rag soaked in lubricating oil will form a useful wick and make for safer lighting, or a burning rag may be thrown into the can from some distance.

To light most fuels you will need kindling, that is material which can easily be ignited. Fine light sticks of standing dead wood make good kindling, particularly if it is softwood. You may also split larger branches into finer pieces, using the dry inside parts if the wood is wet.

Lighting a fire

The four steps in lighting a fire are: start a flame or spark, apply it to tinder, use the tinder to ignite kindling, and the kindling to set fire to heavier fuel.

Before you begin, prepare your fireplace; get your fire-starter, kindling and fuel together; ensure you have enough fuel to keep the fire alight; then build your fire. You build a simple fire by arranging sticks of kindling in the form of a low pyramid. The sticks must be laid close enough together for the flames to lick from one to another but far enough apart to allow air to circulate. A small opening should be left at the bottom for lighting. Once the light kindling is ablaze, lay heavier kindling across it, then add heavier fuel as the fire begins to burn more fiercely. Make sure that the air can circulate freely in your fire. Don't smother your fire by adding heavy wood too quickly or by adding too much heavy wood.

Starting a fire

Match or lighter

The easiest way to start a fire is with a match or cigarette lighter. If you know you are going into the bush, you will naturally carry matches with you, but you may forget that

matches can get wet. Carry two or three supplies of safety matches in different parts of your clothing or pack. Keep them in a waterproof container such as a metal 35 mm film container and seal the lid with waterproof tape. Coat the heads and sticks of the matches with candle grease or nail polish. Enclose the striking sides of a matchbox in the container. Many bushmen prefer to use damp-proof matches, such as Greenlites, rather than safety matches.

If you intend to use a cigarette lighter, get one with a hood and make sure you take an adequate supply of fuel and flints. You might also take matches to make assurance doubly sure.

In some circumstances you can waste many matches trying to start a fire. It is therefore wise to carry a couple of candle ends. A candle is easily lit; it burns longer and more steadily than a match; and it may save matches if dampness or wind make fire lighting difficult.

To light your fire you apply the flame of the match, lighter or candle to tinder. Tinder is a highly flammable material used to catch a spark or flame. Newspaper is the most commonly used tinder in the home but plenty of other—and in many cases better—tinders may be found in the bush. These include dry powdered wood, finely shredded bark, dry grass, birds' feathers or nests, fuzz scraped from bushes or trees, the fluffy pith of a dead palm frond, or a handful of fine, dead twigs which are about the same thickness as a match. To light a bundle of twigs you hold them in one hand and apply the flame to the ends furthest from your hand. Turn the bundle so that the wind blows the flame into the centre. If you can't find dry twigs, take five sticks, each about 25 mm thick, cut away the wet bark and wood on the outside, and make a fronded fire-starter of them by shaving down curls of the dry inner wood. Leave the shavings attached to the sticks. Light the fuzz sticks with match, lighter, or candle.

Many bushmen carry their own tinder. Strips of rubber from bicycle or car tubes, kerosene-soaked rags (carried in an air-tight tin), lint, cotton waste, a kerosene-soaked bandage (which may still be used as a bandage) and Meta (dried alcohol) tablets are popular portable fire-starters.



Fire-starters shaved from dry inner wood

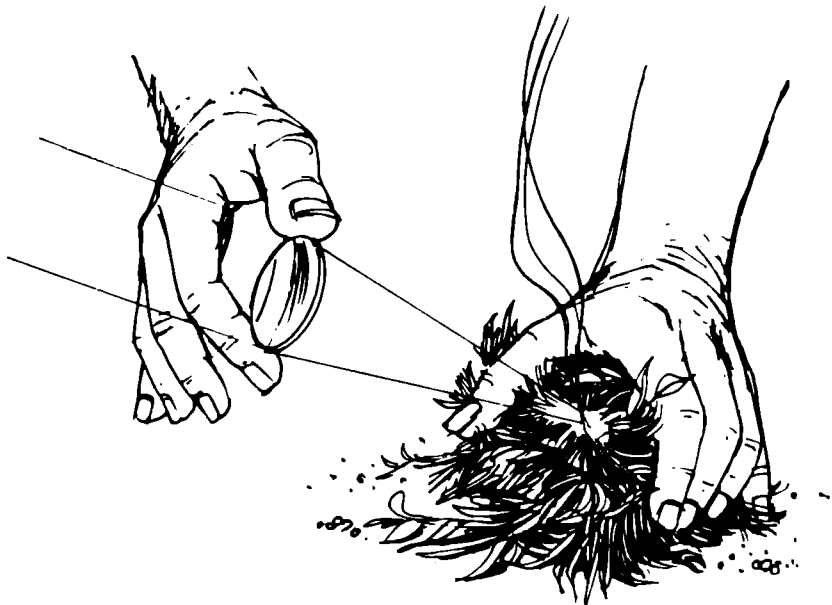
The use of matches or lighter is the easiest way to start a fire, but there are other ways. None of them are easy and the skills required for some of them are acquired, even by experienced bushmen, only with much patience and practice.

Burning glass

You can concentrate rays of sunlight on fibrous dry tinder through any convex lens 50 mm or more in diameter. Lenses from cameras, telescopes or binoculars may be used.

Battery

If you have a car, boat or plane, you can use an electric arc to ignite your tinder. Wind one end of a piece of wire around a battery post and touch the other battery post with the loose end. Direct the resulting spark on to tinder. You may also make an arc by attaching a piece of wire to each battery post and scratching the loose ends together.



Burning glass

Gun and ammunition

Take the projectile or shot out of a round of ammunition, pour half the powder into the tinder, stuff a piece of rag into the cartridge and discharge the round into the air. The rag will burst into flames. Place it on the tinder.

Flint and steel

If any hard, glassy stone such as quartz, agate, iron pyrites or flint is struck with a piece of steel a shower of sparks will be produced. You can get a flame from the sparks by bringing the steel down against the side of the stone and allowing the sparks to fall into a nest of dry, fibrous tinder, then nursing the flame by fanning and blowing. A drop of petrol on the tinder will make it ignite more readily. If you have them, you will find synthetic flints made for cigarette lighters are better than natural flints.

Friction

This is the most difficult method of starting a fire. It involves rubbing wood together to produce a spark which ignites punk. In this context punk may be defined as a wood powder produced by the friction of wood against wood which will produce a spark.

Some natives produce fire by friction simply by rubbing two pieces of wood together using either a circular or a reciprocating motion, but this is a very difficult art to learn.

A more popular, but still difficult, method is the use of the firebow and drill. A wooden drill is rotated in a flat piece of wood so as to produce a fine powder of wood punk and a temperature at the drill point sufficient to start a spark.

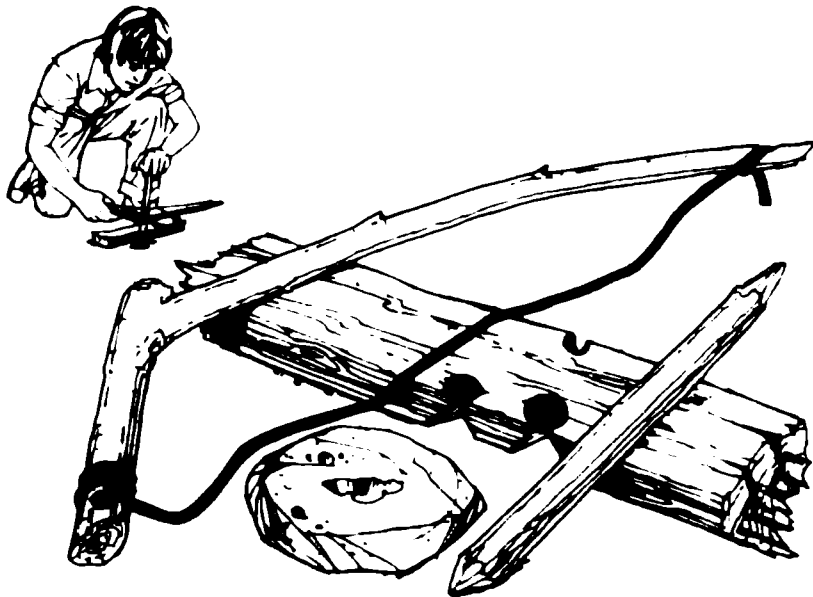
The equipment required is a socket, a drill, a bow, a fireboard and tinder.

The socket, or headpiece, is made from a stone with a small hole in it or a piece of hardwood with a hole in it. As one of its functions is to hold the drill steady, it should be large enough to be held comfortably in one hand. As the top end of the drill must revolve in its hole, the hole of the headpiece should be lubricated. Animal fat, wax, grease, oil or graphite from a pencil will serve as a lubricant.

The drill consists of a straight, cylindrical stick about 300 mm long and 15 mm in diameter. One end is tapered so as to fit into the hole in the socket or headpiece, the other is sharpened to fit into a hole in the fireboard.

The drill is rotated by a bow about 500 mm long. It is made from a strong stem cut from a fork. A piece of the main branch of the fork is left on the stem to become a handgrip which ideally should protrude at about 45 degrees from the stem. A thong of rawhide, leather or shoelace is strung across the bow with sufficient slack to allow a turn or two to be thrown around the drill. It is important that this turn should be outside the drill or, to put it another way, the drill should remain on the outer side of the thong. If it is gripped on the inside of the thong, the thong will be cut by friction against itself.

The fireboard or footpiece is a piece of flat wood with squared sides. It should be about 20 mm thick and long enough



Firebow and drill

to be held down by one foot while the bow is rotated at one edge. The board is prepared for drilling by cutting a drill pit about 15 mm from one edge and an inverted V groove beneath it. The board is placed over tinder so that the punk ground out by the drill falls on the tinder and any spark produced may fall there too.

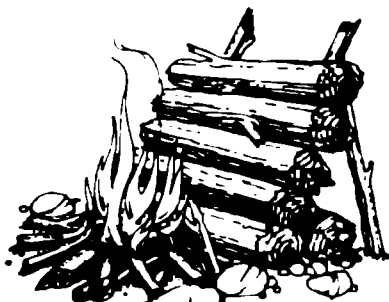
A right-handed person operates the firebow by kneeling on the right knee, placing the left foot on the fireboard, holding the socket with the left hand, bracing the left shoulder on the left knee and the left wrist against the left shin, then rotating the drill by drawing the bow back and forth. The point of the drill grinds out punk as it enlarges the hole. The punk falls into the inverted V groove and on to the tinder. The friction of the drill in the drill pit on the fireboard gradually generates a temperature high enough to make the punk smoulder. When the first thread of smoke rises press the drill more firmly into the pit and increase the speed of the bow

strokes. The sparks that fall on to the tinder then have to be nursed into flames by fanning and blowing. They are normally so small that they can't be seen in daylight so the punk must be blown and fanned gently. Then the tinder may be wrapped around the little coal that results. Blow gently into the tinder ball to keep the coal glowing, stand, then whirl the ball at arm's length to set it alight. Place the ball in the fireplace and start the fire.

Some wood produces punk which lights easily. The best test for useful wood is the feel of the punk. If it feels fine like talcum powder or only slightly gritty, it will light. If it is coarse or fibrous, it probably won't.

Types of fires

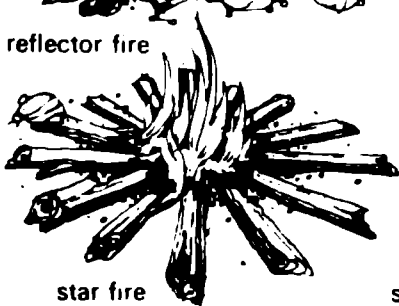
Some general points about types of fires have already been made. For boiling a billycan and most types of cooking a small fire will suffice. A stone or green log fire-guard makes a safer and more effective fire. If you have to heat several cooking



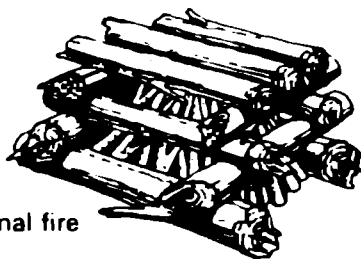
reflector fire



camp fire



star fire



signal fire

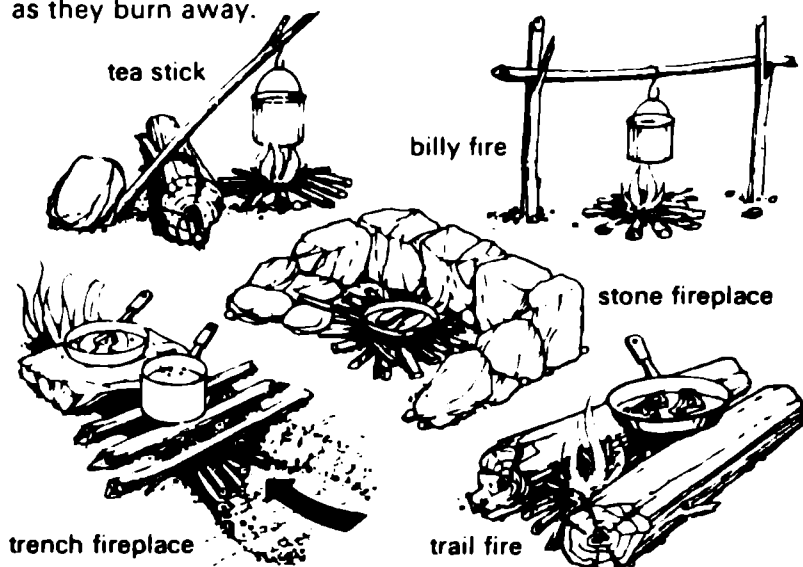
utensils, you can build a long small fire between two green logs or in a trench, or you can build two or three small fires. Cooking rates of different foods may be regulated by hanging the utensils at different heights over the fire.

For boiling a billycan, the standard tea stick consists of a forked stick supported by a log and held down by a stone. A billycan is hung over the fire from the fork.

More heat can be obtained from a fire by building a log reflector or by using a boulder to do the job.

A camp fire used in cold weather is a more substantial construction than a cooking fire. It may be built by criss-crossing three or four large logs in two or three layers and starting the fire with kindling on the top layer. It may also be made by criss-crossing two large logs in each of the lower layers and making the top layer of three or four smaller logs. The starting fire is built on the ground in the centre of the construction.

A 'lazy man's' camp fire suitable for warmer weather may be made by making a starting fire at the junction of two large logs and pushing them together as they burn away, or by laying out more logs in a star shape and pushing them together as they burn away.



Extinguish your fire!

When you have finished with your fire, put it out. You don't put out a fire by kicking or scattering the embers. You douse it in water until it stops hissing and/or cover it thickly with earth. Then throw a bit more water and a bit more earth on it to be doubly sure.

Dos and don'ts of fire making

Do . . .

Clear a circle of one metre radius for your fireplace.

Light it against rocks or boulders or near water.

Keep it small for cooking. ♦

Build it on a platform in wet conditions.

Use standing dead wood for fuel.

Use softwood to start it and hardwood to fuel it.

Gather adequate supplies of fuel.

Keep some fuel under shelter.

Start it with a spark or flame applied to tinder.

Build it with kindling.

Fuel it with heavier hardwood.

Carry matches in waterproof containers.

Have some candle ends in your equipment.

Carry tinder with you.

Use a burning glass, battery, ammunition, flint and steel,
or firebow if you have no matches or lighter.

Extinguish your fire with water and earth.

Don't . . .

Light a fire on grass, moss, peat or pine cones.

Light a fire under a tree or against a tree stump.

Use wood picked up from the ground.

Build big fires or waste fuel.

Run out of firewood.

Smother your fire by adding logs before it is well ablaze.

Waste matches.

Leave your equipment too close to the fire.

Leave a fire without putting it out—right out.

Camps and shelters

5

The best way to survive is to plan to do so, so the best shelter will probably be the one you take with you. If you know you are venturing into the bush, take a little care in planning your shelter. It might mean the difference between death and survival. Determine whether you need shelter from rain, cold, heat, sunshine or insects, or a combination of several of them, and plan accordingly.

Tents

The most popular form of shelter taken on bush trips is a tent. Tents come in many sizes and shapes but most people use the small hikers tent, or the wall tent, or the marquee.

The one-man hikers tent comes in two shapes, the A type and the small wall design. The A type tent is small, light and easily erected but has little room. It is also prone to sweating and condensation, and can be uncomfortable if bad weather forces you to stay inside it for a long time. It is best regarded as an easily carried item to make a roof over your head for a night. The small wall tent provides a little more room, is a little more difficult to erect, but must be regarded in much the same way as the A frame.

Many of the larger tents come in similar shapes, are roomier, but also heavier. In assessing the size of tent you need, a useful rule of thumb is to allow 3.7 m² of floor space for each person (about the area of two single beds). In the larger sizes the wall tent and the marquee are replacing the A type because they offer more headroom and allow the full floor space to be used. But the A type has its uses, particularly in snow country. Its steeply sloping sides are less likely to catch and hold snow than the flatter topped marquee. It is also less likely to have

its roof pumped off by gales. Open-front tents, or lean-tos, are popular because they are cheap, easy to erect and cool, but they will provide inadequate protection in bad weather as they are cold, draughty and difficult to heat.

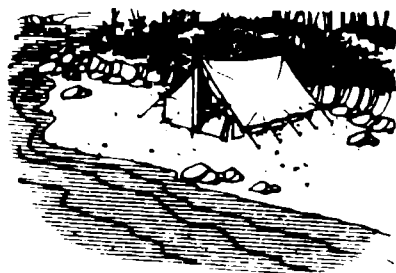
To provide a weather-tight, storm-resistant shelter the wall of the marquee tent should be made of at least nine-ounce duck and the roof of twelve-ounce duck. If it is to be used as a winter tent, it should be thoroughly waterproofed. The most popular material for hike tents in Australia is cheap, light rot-proof japara. A two-man japara tent with floor might weigh about 1.36 kg and is more easily waterproofed than most of the competing synthetic fabrics. The main criticism of synthetic tents is that the waterproofing on many of them is inadequate and some encourage condensation. Some of the synthetics, however, are lighter, stronger and last longer than japara. One of the most important parts of a tent is the ground-sheet. Here synthetics come into their own. Proofed nylon makes the lightest and best groundsheets but it is expensive.



wind-swept ridge—NO



draughty gully—NO



lake shore—NO



near dead tree—NO

Before you erect your tent select your campsite carefully. Don't pitch a tent on a wind-swept ridge, in a draughty gully, or on river banks and lake shores likely to be subject to fog or mist. Don't pitch it under or near a dead tree as a limb may fall on it. Don't pitch it at the base of a steep slope or cliff where there may be a landslide. Avoid dry stream beds which might be flooded in a sudden storm. Don't pitch it near bee, wasp, hornet or ant nests. Choose a site that is safe, well sheltered and near fuel. An ideal place might be near a natural windbreak, such as a stand of trees with branches close to the ground, and on a slope which will provide natural drainage.

After you have selected the site level it carefully. An uneven site can impose unnecessary strains on your tent, or cause it to sag. It can also make you uncomfortable if you have to sleep on the ground. Clear the earth under and around the tent of loose sticks and stones. Chop away branches and roots which might prove a hazard when you are gathering firewood or walking from your fire to your tent. Sweep away dry leaves and debris that might harbour insects.



base of cliff—NO



dry stream bed—NO



insect nest—NO



near natural windbreak on slope—YES

To erect an A type tent lay it out flat and square. Peg down the walls and doors. Set up the poles and head ropes. If you are using material ~~from~~ the site, avoid green timber for the poles. Tie the door flaps. Guy the wall corners out. Increase the tension to eliminate wrinkles. Set the other wall guys and raise the tent to its full height. If the natural drainage is inadequate, dig a drainage ditch 150 mm wide and 130 mm deep around the tent and run it into an outlet that will empty it.

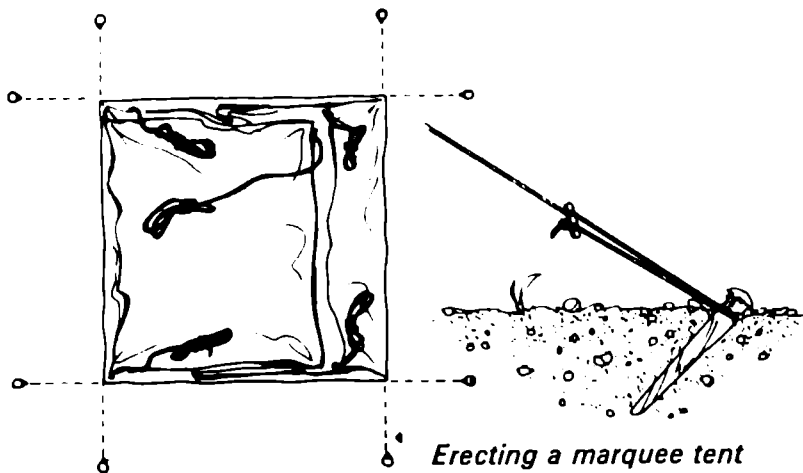
To erect a marquee tent lay it out flat and square with roof uppermost and walls folded under the roof. Take eight pegs, each at least as long as a corner pole, and drive them in parallel to the walls. Erect the corner poles. Guy to the eight pegs. Erect the centre pole(s). With foot ropes at the corners peg down the walls. Lace up the door to the corner poles. Erect and guy the intermediate wall poles. Peg down the foot ropes around the tent.

Drive short pegs vertically into the ground and long ones slanting at an angle of about 60 degrees *towards* the tent so that when the tent shrinks the stakes will be pulled towards it without imposing unnecessary strain on the tent itself. If you are using an axe to drive the pegs use the flat of the axe and remember that a straight, sharp stake will drive cleanly into the ground but a bent one, or one with an angled end, won't. If you are using a flat stone to drive your pegs, hammer the pegs with the edge rather than the flat as it will put more power into the drive and the stone won't break.

If the wind is cold, face the back of the tent into it, or have the front opening cross-wind, which will prevent sparks from blowing back into the tent.

Improvised shelters

If you are stranded in the bush by accident or disaster, you can improvise shelters from natural materials. Indeed, it is possible to make very large and elaborate huts without man-made materials as Richard Graves shows in *The ten bushcraft books* (Dymock's, Sydney, n.d.), but the skills required are better taught at a bushcraft school than with a book. The average



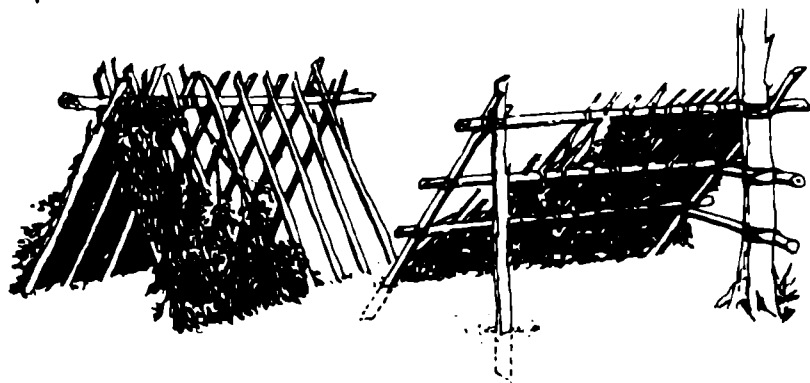
survivor inexperienced in bushcraft will probably be content with simpler shelters and should first look for natural ones.

If the weather is fine, and the climate equable, look for such shelters as caves, overhanging cliffs or rocks, a hollow tree or a fallen trunk. Sheets of bark and piles of branches can improve these. If you use a cave, stay near the mouth where

the air is fresh. Be careful of wet and slippery floors. And don't explore deep caves without tying a string or fishing line to the mouth of the cave so that you can find your way out if you get lost. If you use an overhanging cliff, look for signs of loose earth and rocks which might cause a landslide. You may be able to build a cluster of rocks into a useful shelter by building up the leeward side and making a rough roof out of branches or driftwood or seaweed.

If you are stranded with a vehicle, it might make a useful shelter. A car may be too hot to shelter in during the day in a desert, but it may be used as the basis of a lean-to made from a piece of canvas or plastic. The car itself makes a good survival kit. Its bonnet and boot lid can protect you from the sun and intense radiated heat. Its headlights can be removed and reconnected to the battery to make an effective night signal. If a signal is needed during the day, the tyres may be burnt to produce a cloud of thick, black smoke, or a rag soaked in sump oil may be burnt in a hub cap, or the rear vision mirror may be used as a reflector. Moreover, the radiator may provide a reserve of water, provided anti-rust or anti-freeze solutions have not been added to it.

A rubber liferaft or a canoe or boat turned over or propped against a rock or log may provide a rough shelter—and can be made into a better one with the aid of a sheet of plastic or a tarpaulin or a wall of stones or branches.



Improved A shelter and lean-to

For many years airmen have been instructed in ways of using a crashed aeroplane as a shelter. In fine, cool weather the inside of the plane may be an adequate shelter. Openings can be covered with parachute cloth to keep insects out. Cooking should be done outside to avoid carbon monoxide poisoning. In very cold weather it may be better to make a camp and light a fire. In very hot conditions the plane may be too hot to shelter in and the shade of the wing will be cooler than the inside of the plane. This source of shade can be improved by tying a spread-out parachute as an awning to the wing, leaving it about half a metre clear of the ground so that air can circulate.

Parachutes may also be used in double layers as the covering for various kinds of tents. Metal sections from the plane may be used as tent pegs and poles or the material may be draped over a rope or vine stretched between two trees. Six panels of a parachute will make a two-person teepee but twelve to fourteen will be needed for three persons.

If you have a lightweight space blanket, you can wrap yourself in it, reflecting surface facing outwards, to eliminate harmful radiation from the sun. The space blanket (2 m × 1.5 m, weight 312 g) is also useful in the cold as it will retain up to 80 per cent of your body heat if you wrap yourself with the reflective surface inwards as it reflects heat back into the body. It may be used as a temporary sleeping bag or as a groundsheet or to reflect the heat of your campfire on to your back.

If, however, you have no natural shelters available and no car or plane, you will have to build your own. The simplest type of shelter is the lean-to. It may be made by placing a rope or ridgepole about 2 metres above the ground between two trees or two stakes and about 2 metres apart. When selecting forked stakes to drive be sure that there is a straight drive from head to toe, that the head is bevelled and the toe pointed. Drape a sheet of plastic, tarpaulin or parachute over the ridgepole. The corners and sides may be held down with pegs or stones. More elaborate lean-tos may have sturdier frames and thatched roofs. A framework of battens is lashed

across two forked sticks and long grass, reeds, rushes, ferns, palm leaves or leafy branches may be used as thatching. The thatching may be sewn, tufted or tied on to the battens. The method used will depend on the material available.

If you need warmth, keep your lean-to fairly small. It is better to build two lean-tos for four people than one for them all. And if you do build two, don't build them facing each other with a common fireplace in between. One of them will be filled with smoke. Always build a lean-to so that its front opening is cross-wind.

Outside the lean-to you can build a reflector fire, but don't try to sleep lengthwise along the fire. One side of you will be roasted and the other side cold. Sleep with your feet towards the fire and your head towards the back of the lean-to. You can regulate the heat of the fire by changing the angle of its reflector. The lean-to itself will reflect heat best if its roof slopes at 45 degrees.

Don't sleep on the bare ground. Insulate yourself with a groundsheet, tarpaulin, sleeping bag, soft boughs, or even an inflatable liferaft. If you have to lie on the ground, dig depressions for your hips and shoulders.

If you are caught in the snow you may have to seek other forms of shelter. In dry-cold conditions it is possible for a person who is not exhausted to sleep in a hole in the snow and survive for a short time, provided he is dry and his clothes are adequate for the conditions. But in wet snow just below freezing point and moist wind just above freezing point it is better to seek other kinds of shelter. Try to descend to below the tree line where you may get firewood, but don't try to the point of exhaustion. If you are cold and wet, keep your blood circulating by moving and massaging your limbs. If you have food, eat it. If you have companions, huddle together, but one person should remain awake to ensure that the others don't sleep too long. If you can find a deep snowbank sheltered from the wind, dig horizontally into it, trying not to get your clothes wet as you do so. Hollow out a cave, making the entrance at the bottom so that your body heat will be trapped in the hole. Line the hole with bushes and branches so that



Snowbank shelter

you don't come into direct contact with the snow. Make the roof smooth so that you aren't troubled by drips from knobs and protrusions. Remember that your snow cave must be ventilated.

If you intend to venture into the Australian bush off the beaten track, there are certain survival precautions to take. First, learn as much as possible about the country in which you intend to travel. Second, get a reliable contour map and learn how to read it. Third, get a good compass and learn how to use it. (For details see Chapter 6.) Fourth, keep your knowledge of the country up to date by checking with locals at every available settlement and by listening to the radio for news of hazards.

Fifth, before you leave tell a friend or neighbour where you are going and for how long. Leave a copy of your intended route and itinerary. In Western Australia the police advise that you inform them of your journey into a remote area before you leave. They suggest that you report to any police station en

route, giving the estimated times of arrival and return, the number and names of people in your party, details of rations in your kit, and the name of a person they can contact in an emergency. Northern Territory authorities advise you to check your plans with a reliable local authority before leaving. They say the police and Civil Defence and Emergency Services Road Reporting Posts will give you accurate and up-to-date information on roads.

If you are going with a party or leading one, be sure to plan your journey thoroughly. In their booklet *Survival in the cold* (National Fitness Council of Victoria, 1973) Elery Hamilton-Smith and Roger Trowbridge say: 'Unfortunately, all too often basic steps in planning and preparation are overlooked, and this may lead to a situation in which, to quote one of our colleagues, "death from exposure is merely the logical and inevitable outcome of earlier decision making".' They urge party leaders to make a realistic assessment of the capabilities of party members and of the potential risks and demands. 'We do not accept that challenge should be provided by exposing groups of young people of unknown physical fitness, with insufficient adult support, inadequate training in basic wilderness skills, badly chosen equipment, and little previous experience, to the risk of adverse weather conditions or other natural hazards.' Before venturing into the wilderness members of the party should be trained in basic survival skills. In particular, they should be instructed in the recognition, prevention and treatment of hypothermia. The capabilities of the party member who is the slowest, coldest or most fatigued should determine the pace of the party as a whole. The party should never be spread or scattered. No individual should ever be allowed to separate from it. Clothing should be chosen to suit the conditions—in the cold, woollen underwear, woollen shirt, woollen trousers and woollen pullovers are advisable, with waterproof over-trousers and outer jacket and a woollen balaclava, woollen mittens and over-mitts. Sleeping bags should be down-filled and wall-quilted. Summing up, Elery Smith and Trowbridge say: 'Let us now stress that all of these factors are of the greatest

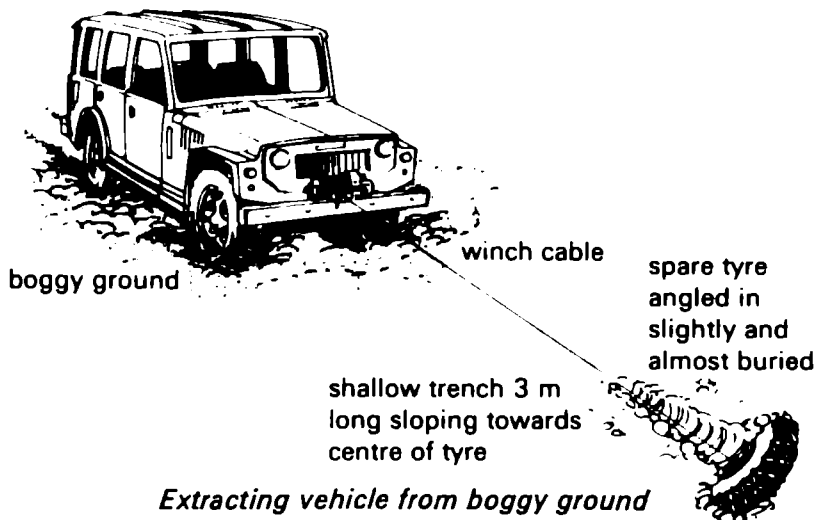
importance even in a relatively humble one-day walk in the country in which conditions may be both wet and cold. Deaths from hypothermia have occurred in air temperatures of 10°C; they have time and time again occurred on journeys which would have been perfectly safe and easy in fine weather; they have usually occurred within some 5–6 hours of setting out. Wet and windy conditions can be fatal at low altitudes, but at high altitudes, anyone leading a party who does not ensure adequate precautions is foolhardy at the best.'

If you are going by car, be sure to have it checked before you leave. Take some basic spare parts, such as a tyre repair kit, coil, condenser, fan belt, radiator hoses and distributor points, but don't overload your vehicle. You might also take an extra jack with a large base plate which will prevent it sinking in sand or mud, 5 litres of engine oil, pump, adequate tools, an axe and a shovel, plenty of water and extra petrol. Some wire, strong cord and a sheet of plastic may be useful. A rifle will help you kill game in an emergency and may also be used as a signal.

Recognised distress signals include three shots, three shouts, three fires or smoke columns in a row, and three flashes of a torch or mirror. See Appendix III for illustrations.

If you are going on a long trip in unpredictable country or unpredictable weather, you should take enough food to last you for a week in an emergency. If you are going into sandy or boggy country, you might need a tow rope. If so, a polypropylene one is lighter than a wire cable. To get out of a bog a bull bag which inflates from the vehicle's exhaust might be useful, and so might either a hand or electric winch. If you are going into heavily timbered country, you might need an axe, or even a chainsaw, to get you past a fallen tree barring the road. Before you leave think carefully about the kind of country you intend to traverse and select the appropriate equipment.

If your vehicle breaks down, stay with it. It will be easier to find a vehicle than it is to find you. Conserve your supplies and energy and stay in the shade. Set distress and smoke signals



and remember that your car can be a survival kit (see page 99).

If you get bogged in sand, deflate your tyres to get better traction. Remember to pump them up again when you get out. Try digging the sand away from the front or back of the tyres. If your vehicle is equipped with a winch, try burying the spare wheel at an angle to form an anchor. Then attach the winch cable to it and drive out.

If you intend to motor in snow, be sure you have plenty of tread on your tyres so that they will grip icy roads. You might reduce tyre pressure by one-third to improve the grip. Add anti-freeze to your radiator so that it won't freeze. Hire or buy chains and fit them correctly. Don't brake suddenly. Use your gears and short pumps of the brake pedal. Don't park with the handbrake on as brake drums may freeze.

If you expect to ford creeks, or you have to drive on a road on which there are sheets of water, you should spray your spark plugs, points and distributor with a dewatering agent. And if you are doubtful about the depth of water you have to drive through, try to estimate its depth before you proceed. You may have to wade into it first (if it's not a strong current).

As a rule of thumb, if the water is no higher than your knees, cross carefully ; if it's higher than that, loosen the fan belt so that the fan doesn't spray water over your engine ; and if the water is above the bottom of your shorts, find another crossing or sit and wait until the water recedes. If you drive into deep water, your car may float. If the water is flowing strongly, it may be swept away.

When you are venturing on a journey into the wilderness you might consider the following items as possibilities for your survival kit :

Map	Signalling mirror
Compass	Torch
Matches	Water bottle
Knife	Stericaps
Notepad	Shovel
Pencil	Hand axe
First aid kit	Bushman's saw
Space blanket or aluminium foil blanket	Plastic sheet
Groundsheet	Spark plugs
Solid fuel capsules	Points
Length of rubber or plastic tubing for a siphon	Radiator hoses
Nylon rope	Car tool kit
Wire	Tyre pump
Cord	Tow rope
Fishing hooks	Bull bag
Candle	Winch
	Chainsaw

Dos and don'ts of shelter

Do . . .

Plan your shelter if you can.

Select your campsite carefully.

Look for a site that is sheltered and near fuel.

Clear and level the site.

Place the opening of your shelter cross-wind.

Look for natural shelters.

Make use of your car or plane.

Learn to make a simple lean-to.

Keep your blood circulating if caught in the snow.

Don't . . .

Pitch a tent on a wind-swept ridge, in a draughty gully, or on damp river banks or lake shores, or under a dead tree, or at the base of a steep slope or cliff, or near insect nests, or in the beds of streams, or on an uneven site.

Face the tent into the wind.

Risk carbon monoxide poisoning by cooking in a car or a plane.

Shelter in a car or plane during hot days.

Build large lean-tos if you need heat.

Build two lean-tos which share a common fire.

Sleep on the bare ground.

Sleep for a long period in the snow.



Direction finding

6

In *The bushman's handbook* H. A. Lindsay says, 'When it comes to direction finding, you can divide human beings into two great classes: those who get bushed and those who don't. Sense of direction is something you enter this world with, and if it wasn't conferred upon you as a birthright you'll never acquire it, no matter how hard you study.' This might be called the bushman's myth and it has a long and honourable tradition in Australia. But Bill Merrill is probably closer to the truth when he says, in *The survival handbook* (Winchester Press, New York, 1972), 'Everyone who enters unfamiliar wilderness country needs a map and compass. It must be remembered that no person is born with the innate ability to find his way into and back out of unfamiliar wilderness country. This prowess is acquired by learning and observing surrounding terrain, and by using a good compass. A good contour map is also a necessity. These two important items complement each other like ham and eggs.'

Maps

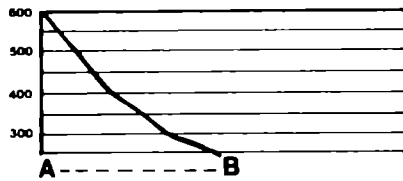
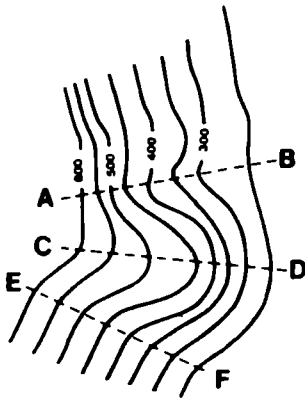
Maps come in many scales and sizes and different maps provide different information. A map is a plan of the ground as seen from above—at a certain time. It is important to note this last point. You can assume that no map is absolutely reliable. Maps go out of date. Towns grow, roads and railways are built, forests grow and are chopped down. Even some of the main natural features of the landscape may change or be changed over time. It is important, therefore, to check the date of issue and revision of your map and to discount its reliability accordingly.



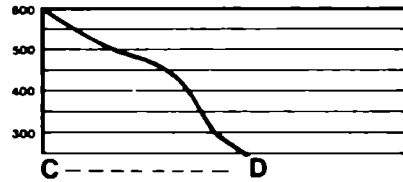
As well as the date, or edition, look for the title of the map, the name, position and numbers of adjoining sheets, the contour interval, the magnetic variation diagram giving the variation between magnetic north and grid north, the grid reference block explaining how to calculate a six-figure grid reference, a legend giving the conventional signs used and their meanings, a magnetic variation block giving the annual magnetic variation, a reliability diagram showing the area of the map produced from aerial photographs, the representative fraction indicating the scale of the map, and a linear scale. Not all maps have all these features. An ordinary road map, for example, lacks most of them. Its prime function is to show major roads and the distances between towns and villages. It is meant for the drivers of motor vehicles.

If you are planning a trip into the wilderness, the best kind of map to take is a *topographic contour* map. It purports to provide as comprehensive a picture of the details of what is on the ground as its scale allows. It will show such things as rivers, streams, hills, valleys, railways, roads and towns. It will also show land shapes and elevations.

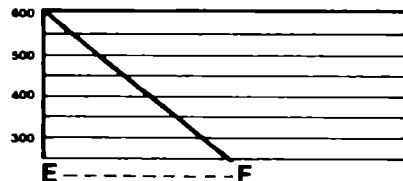
When you look at a topographic contour map you will find it has a specific title stating the area it covers. It will also tell you whether the map was drawn from aerial photographs or field checks or both. It will give you the survey or compilation date, and perhaps a revision date, but even if that date is recent it cannot be trusted absolutely. In his article, 'Unravel the mysteries of your map and compass', in *The good camping omnibus* (K. G. Murray, Sydney, 1975), George Brown makes the point effectively: 'Features change—for instance the latest NSW Lands Dept 1 : 25 000 sheets, surveyed in 1970, revised in 1972 and printed in 1974, show a beach at Burning Palms, and a hostel at Little Marley in the Royal National Park. The hostel was removed in 1973 and the cyclone—it was nothing less—which wrecked the NSW coast in June 1974 removed Burning Palms beach. Were I to map the coast at the time of writing, I would have to depict a rocky shore at Burning Palms—which would in turn become inaccurate when the sand returned.'



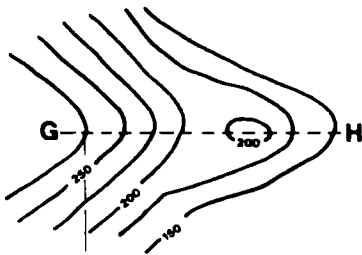
A-----B
section AB—concave slope



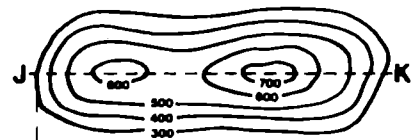
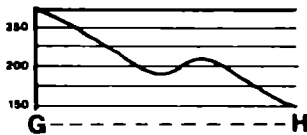
C-----D
section CD—convex slope



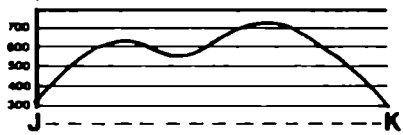
E-----F
section EF—uniform slope



section GH—spur with knoll



section JK—ridge with col



Contours and slopes

The date on the map is also related to the information on magnetic variation (see below). For example, your map might have a diagram showing 'grid north', 'true north' and 'magnetic north' with a statement saying that the relationship between the three is shown diagrammatically for the centre of the map, adding that the magnetic value is correct for 1970—annual change 02' easterly. Brown points out that magnetic north moves east at a rate of two minutes a year in eastern Australia and that many of the 1 : 63 360 army survey sheets are still in use, even though they were surveyed in the 1930s. This means that you should add 1 degree to the east variation shown on one of these maps otherwise you could be 170 metres out in every 10 kilometres. This, as Brown says, is enough to miss a hut in fog or snow and cost someone his life in poor weather in alpine country if you are making a long journey. But most bushmen would regard it as good navigation in rough bush country in normal circumstances.

The map will also show a scale, which is the relationship of the distance between two points on the map and the distance between the two corresponding points on the ground. The three main ways of showing the scale are as a representative fraction—1 : 50 000 means that every distance on the map is 1/50 000 of the distance on the ground; by a linear scale drawn on the map—older maps will show the scale in inch/miles and newer ones may show it in metric measurements; and by a statement (in older maps)—so many inches to 1 mile. On Australian maps the representative fraction is normally shown in the top left-hand corner and the linear scale is normally shown at the bottom of the sheet.

Maps show the shape of the ground, or its relief, by hachures, hill shading, or contours. The most usual way in modern maps is by contours and hill shading at scales greater than 2 : 250 000. With smaller scales layer tints are used. A contour is a line drawn on a map to join all places which, on the ground, have equal height above sea level. The difference in height between contours is called the vertical interval and is shown in the marginal information on the map. The contour interval may change with different map scales, but on the one

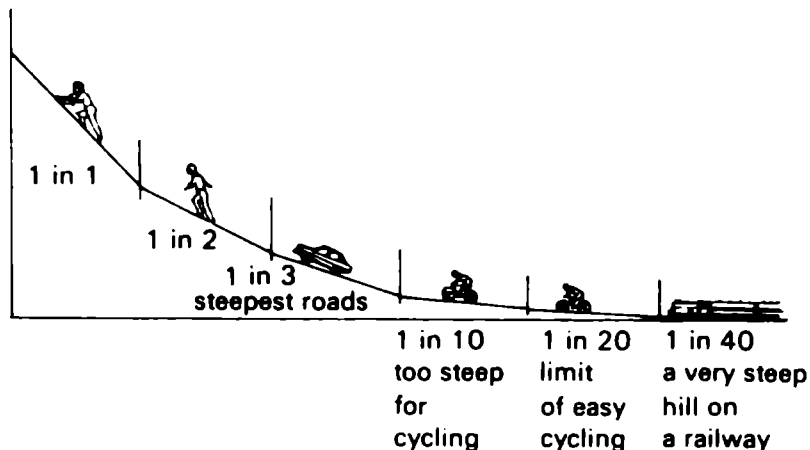
inch to one mile maps (now being replaced by metric scale maps) it is generally 50 feet. On many metric scale maps it is 20 metres. On some, particularly maps of mountainous areas, it may be 40 metres. To be more specific, map scales of 1 : 63 360, 1 : 50 000 and 1 : 31 680 normally have contour intervals of 50 feet, with each 200-foot contour thickened (it's called the index contour). The intervals on metric maps are shown in metres. On the 1 : 100 000 maps the interval is 40 metres in areas of strong relief and 20 metres in flat or undulating areas.

You can read the lie of the land from contour lines if you remember :

1. Contour lines close together indicate steep slopes.
2. Contour lines far apart indicate gentle slopes
3. Evenly spaced contour lines indicate uniform slopes.
4. If the spacing of contour lines, reading from high to low, decreases, the slope is convex and if it increases, it is concave.
5. Contours of a valley make a V shape with the apex towards the head of the valley.
6. Contours of a spur make a V shape with the apex towards the foot of the spur.

You can use the contour lines to calculate gradients, or the slope of the land. A gradient is expressed in the form 1 in 15, which means that in a distance of 15 units horizontally the ground rises or falls 1 unit. To calculate a gradient, measure the distance between two contour lines, then read off the vertical interval of the contours. If the distance between the contour lines represents 120 metres and the vertical interval represents 20 metres, the gradient may be calculated by dividing 120 by 20, which is 6. The gradient is then expressed as 1 in 6 or 1/6. This principle may be stated briefly thus :

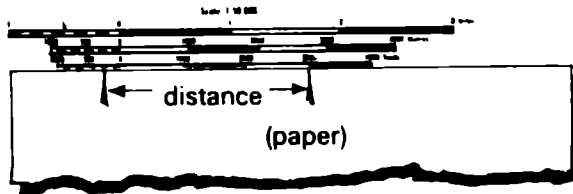
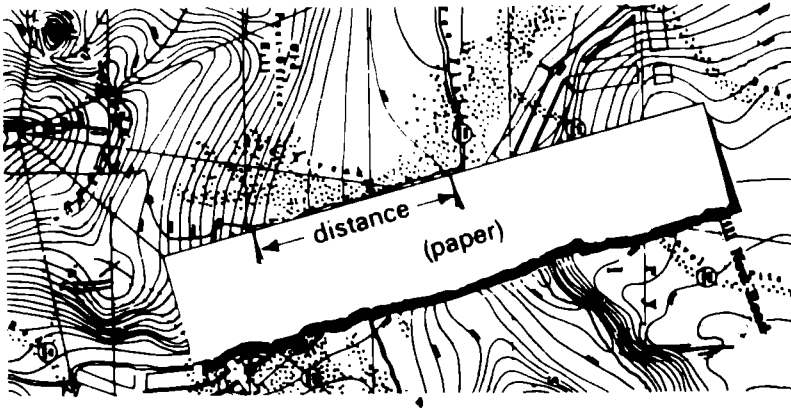
$$\text{Gradient} = \frac{\text{difference in height}}{\text{horizontal distance}}$$



Gradients

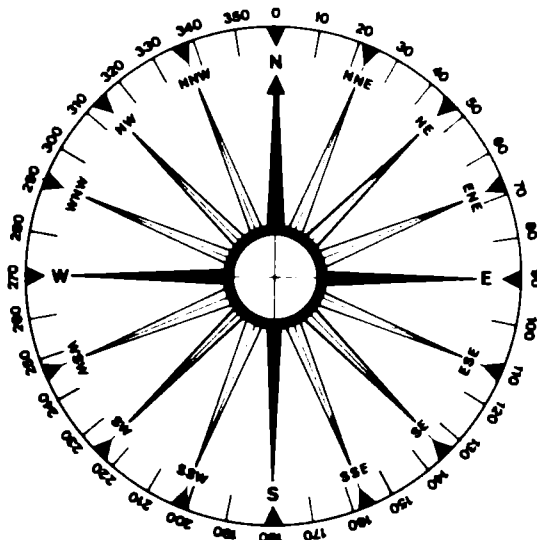
There are many ways of measuring distances on a map. You can use a pair of dividers, a ruler, a length of string, or even a piece of paper. To measure the distance in a straight line between two points on a map, lay the straight edge of a piece of paper against two points and mark the distance on the paper. Then lay the paper along the map's linear scale and read off the distance represented on your piece of paper. To measure a distance between two points that is not along the straight line connecting them, for example the distance between two towns connected by a winding road, consider the distance (i.e. the road) as a number of straight sections and mark out the distance of each section on your piece of paper. The total distance will then represent the length of the road.

Among their other functions, maps also indicate directions according to compass points. The top of most maps represents north, the bottom south, the right-hand side east, and the left-hand side west. Check this by looking for a diagram in one of the margins which shows the main compass points or look for an arrow which is labelled 'true north' on one of the legs and 'magnetic north' on another. It may also have a third

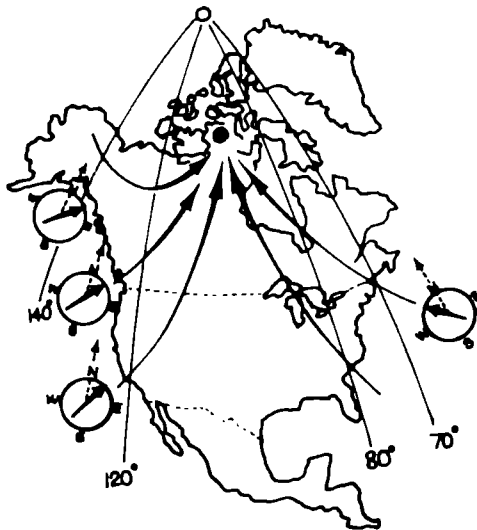


Measuring distance on a map

leg showing 'grid north'. True north refers to geographical north. The earth spins on an axis which passes through the North and South Poles. Lines drawn from the North Pole to the South Pole are true north-south lines. Thus 'true north' is the direction from any point on the earth's surface to the North Pole. But a compass, when pointing north, does not point to the North Pole. It points to a place in the far north of Canada which is known as the magnetic north pole. The direction in which the compass needle points when it points north is called magnetic north. It coincides with true north at only a few places. Moreover, it is not fixed. It moves slightly from year to year. A third north point is given by the grid of the map projection employed to construct the map



Points of the compass



True north is the map direction toward the geographic North Pole; magnetic north is the compass direction toward the magnetic north pole.

detail. Its relationship to true north varies, and the angle between grid north and true north at a point is termed convergence. Directions read off a map using the map grid are always from grid north.

The angle between the true north line and the magnetic north line at any place is called the magnetic declination, or magnetic variation, for that place. But as the magnetic pole moves from year to year, the direction of magnetic north, and therefore the magnetic variation, also changes a little each year. Although this change is not constant, it can be forecast fairly accurately over a number of years. Some maps give details of the annual change in their marginal information. It is important to note whether the annual change has to be added or subtracted. If it is in the same direction as the magnetic variation, it should be added; if the annual change and magnetic variation are in opposite directions, the annual change must be subtracted. George Brown's example of the margin of error possible in using a map from the 1930s should now be understood. To give a specific example, imagine that the annual rate of change is $5'$ per annum easterly and the map was published in 1954. To find the variation for 1978 add 2° to the published magnetic variation to account for the intervening twenty-four years ($24 \text{ years} \times 5' = 120'$ or 2°). Be sure to add the 2° only to the published magnetic variation and not to the compass bearing. The compass does its own compensating.

True north, or grid north, magnetic north and the angle of magnetic declination or variation are important when you are using a compass. Compass bearings taken on the ground must be converted to grid bearings for plotting on a map and grid bearings taken from a map will have to be converted to magnetic bearings before they can be used with a compass on the ground.

To convert from one to another you simply add or subtract the magnetic variation, that is add or subtract the convergence. The safest way to ensure that you do this correctly is to draw a diagram.

Suppose you want to follow a three-stage course using a prismatic compass:

Stage 1 95° from grid north, 920 metres

Stage 2 130° from grid north, 805 metres

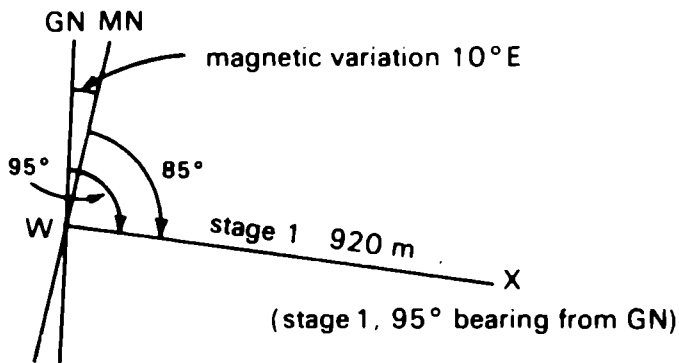
Stage 3 264° from grid north, 1700 metres

Let's assume that the corrected magnetic variation from grid north for this year is 10°E . You can convert the grid bearings to magnetic bearings by allowing for this variation of 10°E of grid north. For stage 1 you subtract the 10° from 95° . Thus 85° from magnetic north would be the direction to follow on your compass to move from X to Y. The correct magnetic bearing for stage 2 would be $130^\circ - 10^\circ = 120^\circ$ and for stage 3 $264^\circ - 10^\circ = 254^\circ$.

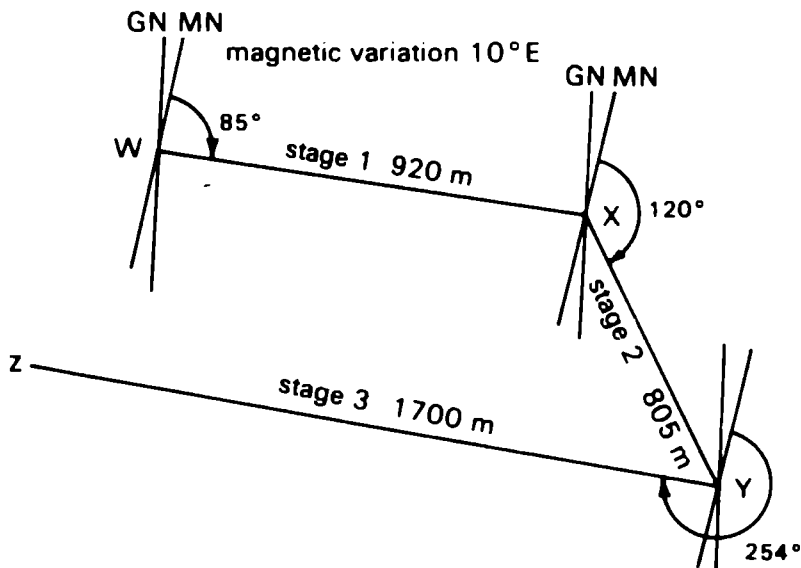
If the magnetic variation on your map was 10° west of grid north, rather than east of grid north, you would *add* rather than subtract the 10° . Thus the correct magnetic bearing for stage 1 would be $95^\circ + 10^\circ = 105^\circ$; for stage 2 it would be $130^\circ + 10^\circ = 140^\circ$; for stage 3 it would be $264^\circ + 10^\circ = 274^\circ$.

Compass

There are many types of magnetic compasses suitable for use in map reading and navigation, but they all operate according to much the same principle. The simple box compass consists of a magnetised needle balanced on a pivot set in the centre of a brass box. A card graduated in degrees is usually fixed to the top of the needle and the 360° mark is directly over the north point of the needle. On the box of the compass is a datum point (north) and, on some compasses, an aiming point or protrusion along the same line. To take a bearing, rotate the compass until the aiming point or datum point is pointing in the direction of the object to which the bearing is to be taken. Read the bearing from the card where the datum point cuts it. When using any magnetic compass remember that your reading may be affected by the proximity of even small quantities of iron, and even by iron ore in the ground. Remove your wrist watch, steel-frame spectacles and belt and stand two or three metres away from any iron or steel gear.



Magnetic north is east of grid north, hence subtract magnetic variation from GN to find bearing from MN. Therefore magnetic bearing is 85° .



Direction:

Grid bearing of X from W = 95°

Grid bearing of Y from X = 130°

Grid bearing of Z from Y = 264°

Distance: WX = 920 m

XY = 805 m

YZ = 1700 m

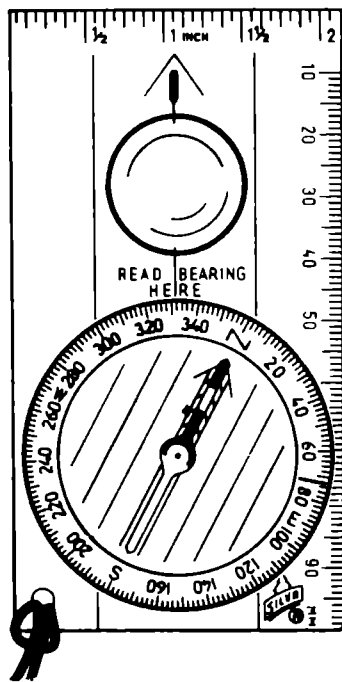
The prismatic compass is a more refined version of the simple box compass. Its box contains liquid to dampen the movement of the card so that it rotates gently and comes to rest quickly. It also comes with a magnifying prism which enables the user to read the bearing on the card more accurately.

To take a bearing with the prismatic compass, hold it in both hands, with a thumb through the ring, and steady yourself against an object. Keep the lid vertical and the prism turned over in the reading position. Look through the prism and line up the prism slot and the hairline in the lid with the object whose bearing you are taking. When the card comes to rest read off the bearing on the card against the hairline.

If you have been given a bearing and you have to find its direction, hold the compass as described, look through the eyepiece of the prism, and turn the compass until the hairline cuts the given bearing on the card. Note some distant object which is in line with the hairline and this will be on the given bearing.

The prismatic compass may also be used without the prism, although the result will be less accurate. Open the compass out flat and line up the tongue with the object. Read the bearing from the *inner circle* on the compass card against the lubber line. To find the direction of a bearing, turn the compass until the inner scale below the lubber line reads the given bearing. The tongue then points in the required direction. The result will be more accurate if you read with your eye vertically over the lubber line.

Perhaps the most popular magnetic compasses used by bushwalkers today are the orienteering compasses, such as those in the Silva range. These are composed of three basic parts: a magnetic needle, a revolving compass housing, and a transparent base plate. The magnetic needle pivots on a sharp point and swings freely on a sapphire bearing. The north end of the needle is normally painted red. The outside upper rim of the compass housing is marked with the four cardinal points, north, east, south and west. The lower rim is divided into degree lines and may be used as a protractor. Each line, for



Parts of the compass

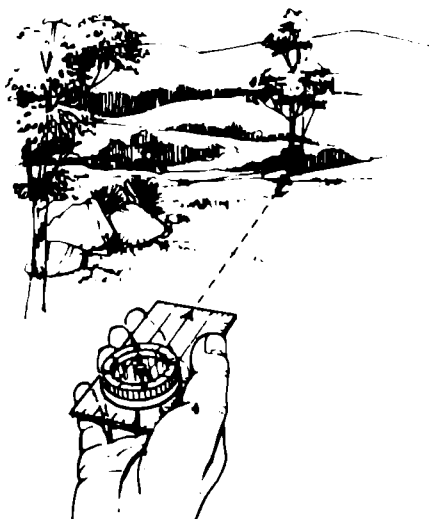
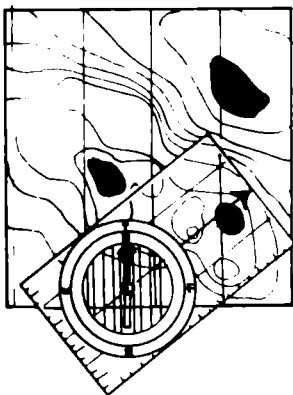
example, might represent 2° in the 360° circle. Some compasses have only one rim on which are engraved both the cardinal points and the protractor markings. An arrow on the inside bottom of the housing points to the 360° mark. This is called the orienting arrow. The bottom may also be engraved with other lines parallel to the orienting arrow. These are called meridian lines. The housing is attached to a rectangular transparent base plate on which a direction-of-travel arrowhead is engraved parallel to the sides of the base plate. The side and front edges have distance scales engraved on them, normally a metric scale in millimetres and an imperial scale in tenths of an inch. More sophisticated models may have a magnifier in the base for reading fine map details, an offsetting scale for the orienting arrow and lines, a case and mirror, a V-sight, and luminous points.

To set your course using your map and compass, place your compass on your map so that one edge of the base plate touches both your starting point and your destination and with your direction-of-travel arrowhead pointing in the direction you want to travel. At this stage it doesn't matter where your compass needle points.

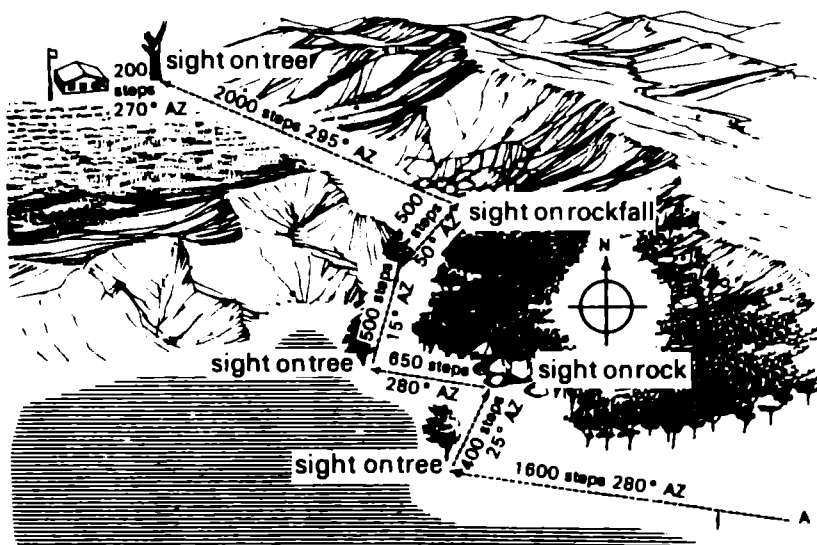
Then turn the compass housing until the orienting arrow on the inside of the housing lies parallel to the magnetic north line on your map. If you use the magnetic north line, you compensate for any variation. Alternatively you can turn the compass housing until the orienting arrow is parallel to the nearest north line (true north) on the map, then add or subtract the appropriate variation which you may find in the map's marginal information. If you have a Silva Ranger 15TD azimuth compass, you will find that it has the orienting arrow on a separate dial in the bottom of the bowl and a fine scale calibrated 90 degrees each way from zero (north). By using a small screw on the dial, you can offset the orienting arrow to the orienting lines to preset a magnetic correction.

To get to your destination, hold the compass before you at waist height with the direction-of-travel arrow pointing straight ahead of you. Turn yourself until the compass needle lies over the orienting arrow on the compass housing with the north (red) end of the needle pointing to north on the housing. The direction-of-travel arrow now points to your destination. Look up and choose a landmark along the line of direction you want to travel and walk towards it without using your compass. When you reach the landmark, take the same bearing and choose a new landmark. Walk towards it. Try to choose landmarks which you can reach in an easy walking stage and set at all points in that stage.

The navigation procedure is more difficult if you can't walk in a straight line to your destination or you want to walk around obstacles because it is easier. The way to do it is to turn 90° to the right or left of the obstacle, count the number of steps it takes you to clear it. Follow your original course until you have walked past the obstacle. Then turn right or left—whichever is appropriate—and return to your first line of



Using an orienteering compass



Plotting a course

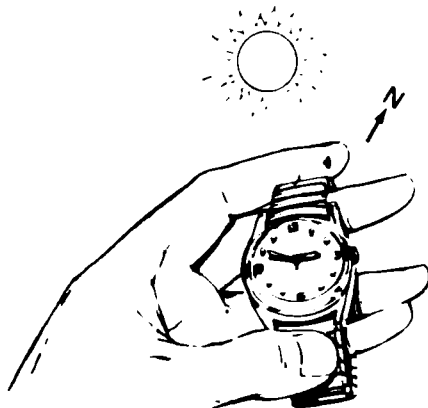
direction by counting the same number of steps back to it as it took you to clear the object. Your calculations may be helped if you know the length of your pace. You can get this by measuring several 100 metre walking courses, walking each course several times and counting paces. If you average 120 paces to walk 100 metres, then every 120 paces may be used to represent 100 metres when calculating with map and compass. Allowances will have to be made for shorter paces on steep climbs or descents. Time is also a useful guide to distances you walk. Check on how far you walk in 15 minutes, half an hour, and an hour.

To return to your original starting point using your compass, you work backwards. On the trip out you held the compass with the arrow pointing away from you towards your destination. On the way back you hold it with the arrow pointing towards you. Orient the compass by turning your body until the north point of the compass needle points to the north of the compass housing. Choose a landmark in front of you as an aiming point and walk towards it. When you reach it, orient your compass again and choose another landmark to walk towards. Continue with this process until you reach your original starting point.

If you want to sight at a back checkpoint, or you want to return along the way you came, you take an azimuth reading. This is a reading to which you add or subtract 180° . If your bearing for the journey out was 90° , or due east, the azimuth reading for returning would be 90° plus 180° , which is 270° , or due west. But if your bearing for the journey out was more than 180° , you would subtract 180° for the bearing home, or for a backsight. If you travelled out on 280° , you would travel home on 280° minus 180° , that is 100° . This method is useful not only for returning along the route on which you came but also for checking your bearing as you go out by taking a backsight, or reverse reading.

You can also get a rough indication of direction from the sun by using your watch. Hold the watch so that the 12 on the dial points to the sun. North will fall on a line bisecting the angle between the 12 on the dial and the hour hand. This will

not apply, however, north of Capricorn in midsummer and is less accurate near noon than later or earlier in the day. If the sky is overcast, hold a match vertically above the 12 and touching the face of your watch. Turn the watch until the shadow formed by the match passes through the centre of the watch, that is from the 12 to the 6. To get true north, bisect the angle between the hour hand and the shadow line.



Finding direction from your watch

You can also find direction from the sun at noon. You can establish your longitude from local apparent noon, the direction from the sun at noon, and latitude by the noon altitude of the sun. To find longitude, you must know the correct time. Thus it helps to know how much your watch gains or loses each day. Correct the zone time on your watch to Greenwich time; for example, if your watch is on Eastern Standard Time, subtract 10 hours to get Greenwich time. In summer remember to adjust for daylight saving. You can find longitude by establishing the time the sun passes your meridian (the local north-south line). Put a stick in the ground. Check that it is vertical by using a makeshift plumb bob. (A heavy object tied to a bootlace will make a plumb bob.) Before midday begin to mark the position of the end of the stick's shadow and note the time for each mark. The time of the shortest shadow will be

local apparent noon. Jot down Greenwich time of local apparent noon, then correct for the number of minutes the real sun is ahead of or behind the mean sun. The mean sun is an astronomical concept based on the assumption that the sun rolls along the equator at a constant rate of 15° an hour, which is not true. You can then calculate from the following table the number of minutes of time to be added or subtracted from mean (watch) time to get apparent (sun) time.

Now that you have the Greenwich time of local noon, you can find the difference of longitude between your position and Greenwich by converting the interval between 1200 Greenwich and your local noon from time to arc. Remember that 1 hour equals 15 degrees of longitude, 4 minutes of time equal 1 degree of longitude, and 4 seconds of time equal 1 minute of longitude.

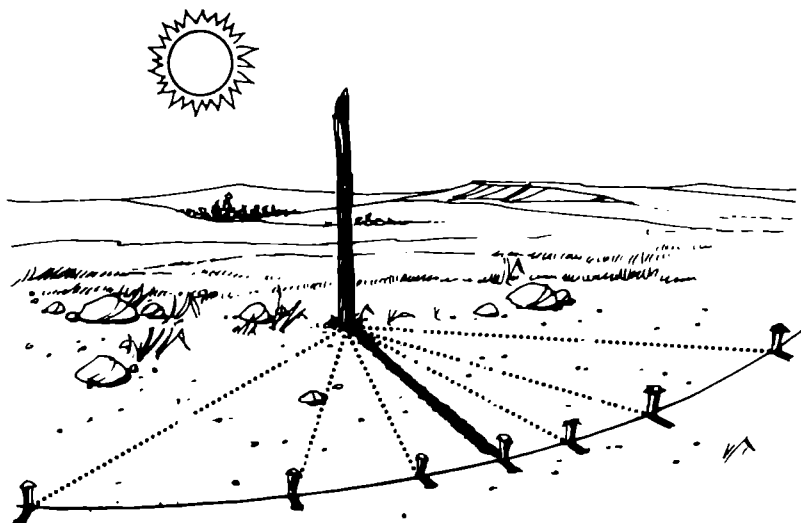
Example: Your watch is on Eastern Australian Standard Time, defined at the 150th meridian east, and normally loses 30 seconds a day. You haven't set it for 4 days. You time local noon at 1508 on your watch on 4 February. Watch correction is 4×30 seconds or +2 minutes. Local noon on the meridian is in terms of the apparent sun, not the mean sun on which Eastern Australian Standard Time is built, and hence the equation of time correction must also be used. The correction for 4 February is —14 minutes. Hence the mean time of noon is 1456. That is you must be 2 hours 56 minutes west of the standard meridian. Or, to put it another way, you are 7 hours 4 minutes east of Greenwich, which is a longitude of 106° .

You can also find direction from your stick and shadow. The line of the shortest shadow will be the line of the local north-south line (meridian). Whether the sun is north or south of you at midday will depend on your latitude. North of 23.4°N , the sun will always be due south at local noon and the shadow will point north. South of 23.4°S , the sun will always be due north at local noon and the shadow will point south. In the tropics the sun can be either north or south at noon, depending on the date and your position. To put it in Australian terms, at noon in winter in the Southern Hemisphere the sun will be due north and the shadows will point south. This will not always

Equation of time

Date	Eq. of time *	Date	Eq. of time *	Date	Eq. of time *
	min		min		min
Jan. 1	-3.5	May 2	+3.0	Oct. 1	+10.0
2	-4.0	14	+3.8	4	+11.0
4	-5.0	May 28	+3.0	7	+12.0
7	-6.0			11	+13.0
9	-7.0	June 4	+2.0	15	+14.0
12	-8.0	9	+1.0	20	+15.0
14	-9.0	14	0.0	Oct. 27	+16.0
17	-10.0	19	-1.0		
20	-11.0	23	-2.0	Nov. 4	+16.4
24	-12.0	June 28	-3.0	11	+16.0
Jan. 28	-13.0	July 3	-4.0	17	+15.0
				22	+14.0
Feb. 4	-14.0	9	-5.0	25	+13.0
13	-14.3	18	-6.0	Nov. 28	+12.0
19	-14.0	July 27	-6.6		
Feb. 28	-13.0			Dec. 1	+11.0
		Aug. 4	-6.0	4	+10.0
Mar. 4	-12.0	12	-5.0	6	+9.0
8	-11.0	17	-4.0	9	+8.0
12	-10.0	22	-3.0	11	+7.0
16	-9.0	26	-2.0	13	+6.0
19	-8.0	Aug. 29	-1.0	15	+5.0
22	-7.0			17	+4.0
26	-6.0	Sept. 1	0.0	19	+3.0
Mar. 29	-5.0	5	+1.0	21	+2.0
		8	+2.0	23	+1.0
Apr. 1	-4.0	10	+3.0	25	0.0
5	-3.0	13	+4.0	27	-1.0
8	-2.0	16	+5.0	29	-2.0
12	-1.0	19	+6.0	Dec. 31	-3.0
16	0.0	22	+7.0		
20	+1.0	25	+8.0		
Apr. 25	+2.0	Sept. 28	+9.0		

* Add plus values to mean time and subtract minus values from mean time to get apparent time.



Finding direction from stick and shadow

apply in summer in the area north of Capricorn. For example, at noon in Cape York, Darwin and northern areas of Western Australia the sun will throw short shadows to the north, particularly during December. Remember to convert the time to true noon if it is summer and your watch is set for summer (daylight saving) time.

Since this book was first published Mr Norman Thompson of Brisbane has pointed out that if the stick is positioned on flat ground the track of the shadow of the tip of the stick may appear to be a straight line having a bearing of true east and west. Local noon occurs when the shadow of the vertical stick makes a right angle with the east-west line. Measuring the shortest shadow is tedious and may be inaccurate, but observing a right angle is easy, accurate and can be done *before* noon. This makes the determination of noon more accurate.

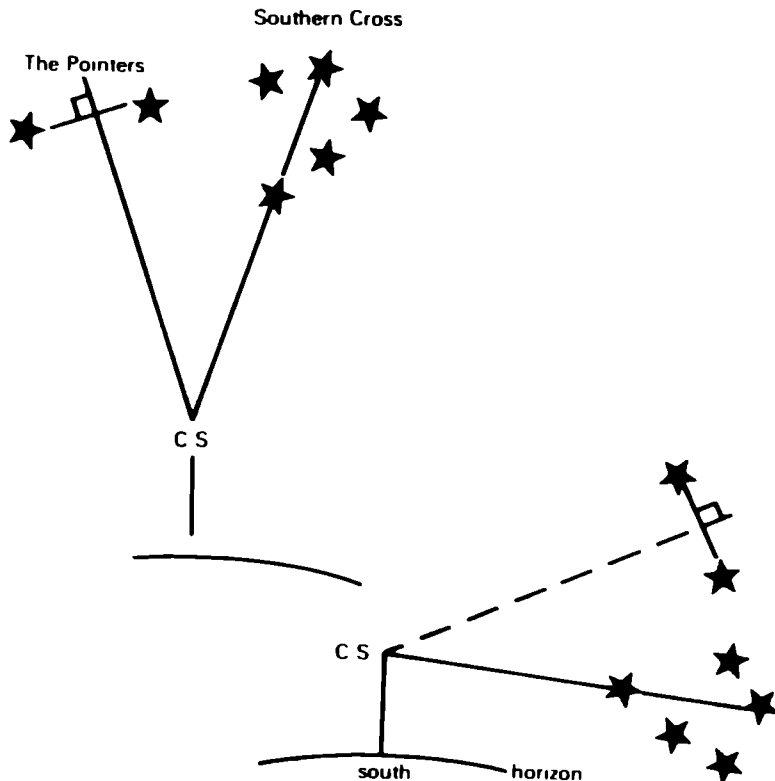
The stars are also useful for finding direction. In the Southern Hemisphere the Southern Cross is the most distinctive constellation and an imaginary line through the long

axis of the Cross points towards the South Pole. It is important not to confuse the true Southern Cross with the False Crosses. The False Crosses are less bright and their stars are more widely spaced. The True Cross has pointers and two of the stars in the True Cross—those on the southern and eastern arms—are among the brightest in the heavens.

The sky above the South Pole is known as the Coal Sack as it is very dark compared with the rest of the sky. You can locate the spot within the Coal Sack which is exactly above the South Pole by holding the illustration of the True Cross and False Cross above your head. Note the two very bright stars just to the east of the True Cross. First, extend an imaginary line along the axis of the True Cross to the south. Join the two bright stars to the east of the Cross with an imaginary line. Bisect this line with one at right angles. The intersection of this line with the line through the Cross is roughly the point above the South Pole.

You can use your sun and star directions as a check on your compass. Sight on, say, the sun and note its magnetic azimuth. The difference between this magnetic azimuth and the true azimuth will be the magnetic variation at your position. Note this variation and check it with the variation given on your map. For example, the magnetic azimuth of the sun at midday is 190° . The true azimuth is 180° . Subtract 180° from 190° and you get 10° . The variation is 10°W . Subtract 10° from your magnetic azimuth to get true azimuth. If the difference is less than 3° , check again before changing your map. If even a small difference is constant, adjust your map to correspond with your observations, but first make sure that no iron or electrical fields are close to your compass while using it. If there is iron in the rocks around you, you will notice a change in your compass reading if you vary the distance from compass to rock.

A good map and compass are the most useful tools in direction finding because they are generally more accurate than human judgment, but observation is almost as important—experienced bushmen would say more important.



Finding celestial south (CS) and true south at night, with the Southern Cross and Pointers in different positions in the southern sky.

The Hobart Walking Club offers two pieces of advice to its members: remember the short view and don't forget the long view. As you move note such physical features near you as ridges, creek valleys and rock outcrops and keep looking behind you because the route back won't look the same as the route out. As H. A. Lindsay puts it in *The bushman's handbook*, 'Now get this fact firmly in your mind: the sides of trees, rocks,

hills and the scenes which you will see on the outward journey are *not* what you will see on the way back. Things often look vastly different when viewed from the other side, so make it a habit to look behind you every few hundred yards. Memorise what you see, and then on the way back everything will seem familiar because it has been seen before.' And when you look ahead and behind don't look only at the area close to you. Note distant landmarks. Try to fix in your mind the general trend of your route over long distances. In dense forest, of course, you may have no distant views and you might be reduced to following a course by lining up three trees. Blazing trees, bending bushes and overturning rocks or logs may help to create landmarks in country such as this where landmarks are few.

As you travel keep a sketch map showing where you've been and what you've seen. Mark in the distances you've travelled and the direction you've followed. Then if you have to retrace your steps you have a record of them.

Try to follow a direct route, but don't waste your strength trying to surmount major obstacles if you can walk around them in a reasonable time. Don't labour straight up a steep slope. Zigzag up it to save energy. Skirt gullies and swamps if possible. Don't force the pace. Walk steadily and rest often. When resting face the direction of travel, or make a pointer which does. Let the pace of the slowest member be the pace of the party, otherwise you will become separated.

Use your eyes and ears. Look for human trails, animal trails and signs of human habitation. Listen for the sound of rivers and surf. Use your nose to detect the smell of the sea or the smell of smoke.

If you can't use your eyes and ears and you can find reasonable shelter, stop. Don't try to battle on blindly through storm or fog. Camp and wait for visibility to improve. If there is no storm or fog, remember that every day there will be darkness. Make camp before it gets dark. Don't forget to indicate the direction of travel each time you stop.

If you have to travel at night, steer by the stars and whatever landmarks you can see, but this is inadvisable except in

emergencies. Night travel is easier if you have a compass, but it is rarely really easy. Remember that you can get a rough indication of the location of the south celestial pole by extending in an imaginary line the distance between the star at the head and the one at the foot of the Southern Cross three and a half times. H. A. Lindsay warns that the surest way to get lost at night is to carry a lantern before you. You tend to lose yourself in a circle of light. In the daylight you are likely to lose yourself, unless you are following landmarks, because of the natural tendency of human beings to walk in circles.

If you do get lost, stop. Don't panic. Sit down and think. Examine your map if you have one. Can you recognise any landmarks? What was the last one you saw? Get out your sketch map. Compare the two. Is the map in error? If not, ask yourself whether you have drifted to right or left, or whether you have passed your objective. Did you walk around an obstacle and fail to take account of it? Do you have a record of the time or distance you have travelled? Try to reconstruct the course you have taken since you left the last known point. Climb a hill or tall tree and look around.

If you are really lost, stay where you are. Try to make yourself and your camp easily visible. Brightly coloured garments, space blanket, groundsheet or plastic may help, so may signals in the sand, if there is sand. Light a fire and keep it smoking. Be prepared to signal to rescuers. Remember that if there is a search for you, it may be conducted by ground and air. Conserve your water, your food and your energy. Don't blunder about. See Appendix III for illustrations of search and rescue signals to be used.

If you decide to walk out, leave a dated note at each camp and leave plenty of evidence that you've been there. Indicate where you are going next and outline the physical condition of members of your party.

If you are in the desert, don't travel unless you are certain you can reach your destination or another water supply. If you have to jettison equipment, don't jettison water or anything that may be used as a sunshade. Water is more important

than food. If the days are hot, remain in the shade and travel only at night.

Wherever you are, try to find a trail and follow it. At forks take the trail that looks the most travelled. Don't blunder through difficult obstacles. Don't climb over logs if you can walk around them. Don't crash through vegetation; push it aside. Follow the easiest route possible. Above all, don't panic.

Always report your return. There may be people still looking for you. If you registered details of your party and trip with the police before leaving, be sure to report to police on your return.

4

You give first aid to a person to sustain his life, prevent a deterioration in his condition and promote his recovery. In survival situations the most likely injuries will be failures in respiration, shock, cuts and bruises, fractures, sprains, strains and dislocations, blisters, boils, infections, burns, scalds, bites, stings, concussion, and exposure to heat and cold. If there is no chance of getting an injured person to a doctor, first aid will also have to be final treatment. The main aim then will be to prevent loss of life and either to prepare the patient for movement or to be less of a problem to the survival party. Don't stand by and let him die. See Appendix IV for illustrations of methods of carrying injured people.

In dealing with an injured person do the following :

1. Protect him (and his rescuers), e.g. remove the cause of his trouble (a fallen tree limb from his leg) or remove him from the cause (fire or water).
2. Check whether the patient is conscious or not. If not, treat his injuries in this order :
 - Clear his airway : clear vomit from his mouth ; remove his false teeth and pull his tongue forward.
 - Check and maintain his breathing ; administer emergency resuscitation if necessary (mouth-to-mouth or mouth-to-nose).
 - Stop or control serious bleeding—apply direct pressure, with bare hands if necessary ; then apply dressings, pads and bandage firmly ; apply more of them over the original dressings if bleeding continues.

- If he is unconscious, place him in the recovery position as illustrated below. Handle him gently and move him as little as possible.
- If he is conscious, keep him lying down and keep him warm if he has symptoms of shock.
- Immobilise fractures and injured parts.

External bleeding

Place a sterile pad or adhesive dressing on the wound and apply pressure by hand or by bandaging firmly. A clean, folded handkerchief sterilised with boiling water or alcohol will do in an emergency. If the wound is large, you may have to apply pressure for up to 15 minutes. Press the sides of the wound firmly together. Pick off any foreign bodies or wipe them off with a dressing. Wash the wound and the area around it, if possible. Apply more dressings and pads over the



The recovery position

original dressings if bleeding continues and bandage more firmly. Ensure that dressings and pads cover the whole wound. Raise the injured part, unless you suspect a fracture. Don't give your patient any stimulants until the bleeding has stopped. Keep him quiet, keep him comfortable, and reassure him.

Internal bleeding

Some indications of internal bleeding are the coughing of blood, the flow of blood from an ear or nose, vomiting of blood, or the passing of blood in urine or faeces.

Have the patient lie down with legs raised. Tell him not to move. Loosen tight clothing around neck, chest and waist. Turn his head to one side if he is vomiting. Warm him and reassure him. Don't give him anything to eat or drink.

Special areas

If the patient is bleeding from the ear, keep his head slightly raised and incline it to the side of the injury.

If he is bleeding from the nose, have him sit, with his head slightly forward. Tell him to breathe through his mouth and pinch the soft part of his nose for about 10 minutes. Tell him not to blow, pick, or rub his nose for several hours.

If he is bleeding from the palm of the hand, cover the wound with a dressing, place a pad over the dressing, and clench the fingers firmly over them. Bandage with a folded triangular bandage and tie off across the knuckles.

If he is bleeding from an open chest wound, try to prevent air entering the chest cavity as it may collapse the lungs. Place a hand firmly over the wound. Have the patient lie down. Cover the wound with a dressing and thick pad of cotton wool, applying the pad at the moment of maximum exhalation, just before more air is sucked in. It should be firm enough to seal the wound but not tight enough to prevent chest movement.

If he has a bruise (bleeding beneath unbroken skin) apply cold, wet pieces of cloth, or an icebag, to the bruise.

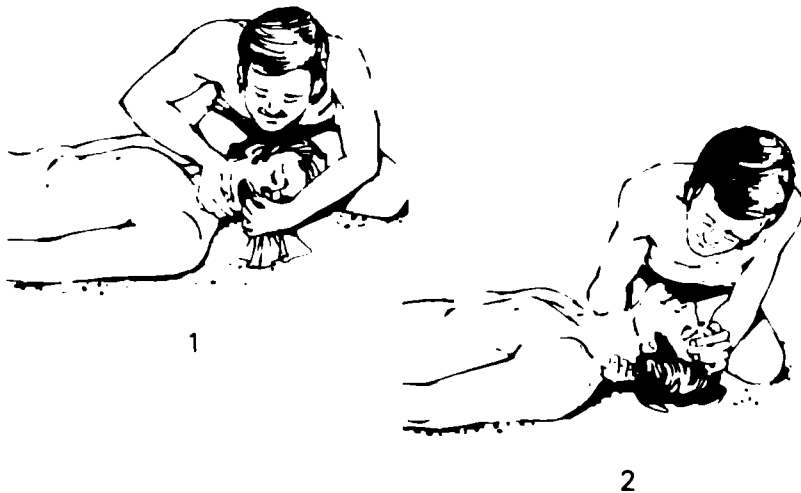
Resuscitation

Respiratory resuscitation is administered to restore the supply of oxygen to the blood and to restart the heart to maintain circulation and ensure that the oxygen reaches the brain and other organs. Survival situations which might cause asphyxia—an interference with respiration—would include drowning, gas poisoning and being overcome by smoke. The patient is normally unconscious, his breathing stops, the face and lips are blue, flushed or pale, the pulse is weak or absent, and the heart erratic.

The aim of respiratory resuscitation is to restore the supply of oxygen quickly and it is important to give the first few inflations of the lung quickly. The most effective method is mouth-to-mouth or mouth-to-nose resuscitation.

Place the patient in the recovery position to clear his mouth of vomit; remove his false teeth if any. Support the nape of the neck. Push the head back and the chin up by

Mouth-to-mouth resuscitation





3



4



5



6

placing one hand on the forehead and one on the chin so that the tongue moves forward clear of the airway.

Loosen the patient's clothing at neck and waist. Pinch the patient's nostrils together if using mouth-to-mouth resuscitation, or the nose can sometimes be sealed off effectively by your cheek. If using mouth-to-nose resuscitation make sure his mouth is closed. Inhale deeply. Seal your lips around his mouth or nose. Blow forcibly into his mouth or nose until his chest rises. Remove your mouth and his chest will fall. When his chest falls listen for air escaping from his mouth. Repeat rhythmically at 15 inflations a minute.

If the patient is a child, blow gently at 20 inflations a minute.

If the patient's chest does not rise, check again for an obstruction.

When breathing begins place the patient back in the recovery position.

If the heart is beating normally, continue artificial respiration until natural breathing is restored. You can check the heart beat by feeling for the carotid pulse in the neck just above and to the side of the Adam's apple, using the first or second fingers of either hand.

If the pulse is absent and you have been trained in external cardiac compression, begin heart-lung resuscitation. Lay the patient on his back on a firm surface.

Kneel at the side of the patient. Feel for the lower half of the breastbone and place the heel of your hand on it, keeping your fingers and palm off his chest. Place the heel of the other hand over the first one.

With arms straight, rock forwards, pressing the breastbone downwards 40–50 mm every $\frac{3}{4}$ second, that is 80 times a minute.

Interrupt compressions to permit ventilations as follows :

If one operator:

2 lung inflations

15 chest compressions at the rate of 4 full cycles every minute

If two operators:

1 lung inflation

5 chest compressions at the rate of 12–15 cycles every minute

Shock

Shock is a depressed state of all body functions and is caused by injuries, severe pain or sudden illness. If it is not treated, it may cause death. Any injured patient should be treated for shock.

Shock may be caused by exposure, pain, severe bleeding, fatigue, broken bones, acute internal injuries, recurrent vomiting, burns and crushing.

The patient's skin becomes cold, moist, pale and clammy. His eyes may become vacant, his pupils dilated. His vision may be blurred. He may feel faint, sick and thirsty. His pulse may be weak or irregular or rapid, or it may be absent. His breathing may be shallow and irregular.

To treat him, keep him lying flat with his head low and turned to one side. Raise his legs about half a metre unless his head, chest or abdomen is injured. Loosen his clothing at neck, chest and waist. Keep him warm enough to prevent shivering but don't heat him as this draws blood from the vital organs to the skin. If he complains of thirst, moisten his lips, but give him nothing to drink. Don't move him unnecessarily. Keep him calm.

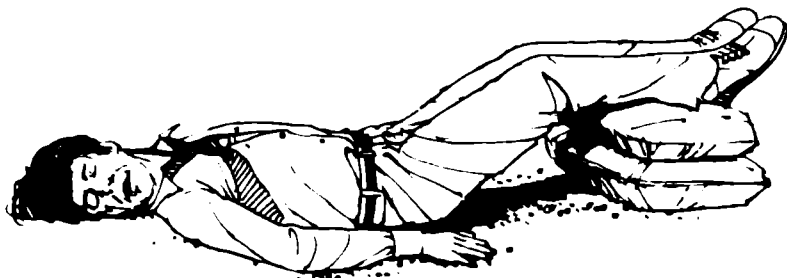
Fainting

Fainting is a temporary inadequate supply of blood to the brain. It may follow a fright, fatigue, injury or debilitating illness and may be signalled by swaying, unsteadiness, giddiness, pallor and sweating.

Treat the patient for an impending faint by reassuring him and telling him to breathe deeply. Get him to flex the muscles of his legs, thighs and buttocks to restore circulation.

Loosen his clothing at neck, chest and waist. Lay him in a current of fresh air or have him sit with his head between his knees.

If he faints, lay him down. Raise his legs above the level of his head. Ensure that he has fresh air and shade. Loosen his clothing at neck, chest and waist. Gradually raise him to a sitting position.



Treatment for shock or a faint

Bone fractures

A fracture is a broken or cracked bone. It can be caused by direct or indirect force. The skin surface may remain unbroken or the ends of fractured bones may protrude through it. Sometimes the crack of the breaking bone may be heard.

A fracture is accompanied by pain and tenderness at the break and sometimes by swelling and bruising. The patient is unable to use the injured parts or move adjacent joints. Some fractures cause deformities such as irregularities of the bone, a shortening, angulation or rotation of a limb, or the depression in a flat bone such as the skull.

When treating a patient with a fracture, treat asphyxia, bleeding and severe wounds first. Cut away clothing and stop the bleeding. Immobilise the fractured bone and adjoining joints by bandaging the broken limb firmly to the body or to a well-padded splint. Then raise the injured part, if possible.

Check from time to time to ensure that the bandage is not tight enough to stop circulation of the blood.

Skull fracture

A fracture of the cranium is caused by a direct blow or a fall on the upper part or on the sides of the skull. A fracture of the base is usually caused by a blow to the lower jaw or a fall on to the feet or lower part of the spine.

The patient may be dazed or unconscious. He may be bleeding from the ear, nose and mouth.

Place him in the recovery position. If blood comes from the ear canal, apply a sterile dressing. Ensure the airway is clear. Start artificial respiration if breathing begins to fail. Avoid unnecessary movement.

Lower jaw fracture

The patient experiences pain when he swallows or otherwise moves his jaw. He finds it difficult to speak. There is an excessive flow of saliva, and swelling, tenderness, and then bruising of the face and lower jaw.

Keep the airway open. Control bleeding. Remove false or broken teeth. Support the jaw with a hand-held pad or bandage.

A conscious patient who is not severely injured may sit, head forward, so that secretions can drain. Other patients should be kept in the recovery position.

Rib fracture

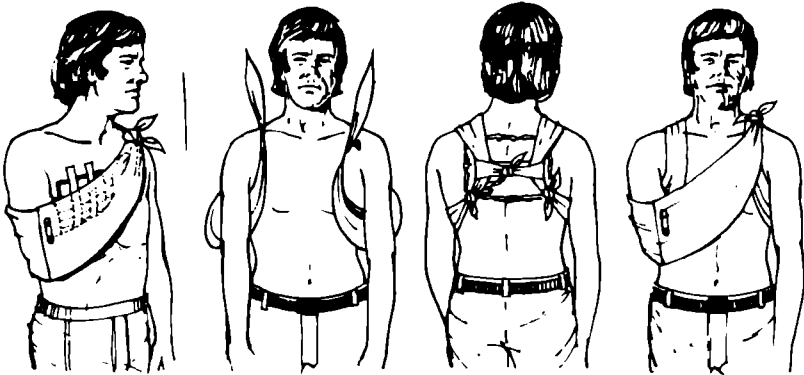
The patient experiences severe pain around the rib when he coughs or breathes deeply, so he takes shallow breaths. If the lung is punctured, he may cough blood. He may also have a 'sucking wound' in the chest.

If the fracture is uncomplicated, place the arm on the injured side in a sling. If there is a sucking wound, make it airtight. Lay the patient down, head and shoulders raised, the body inclined towards the injured side.

Collar-bone fracture

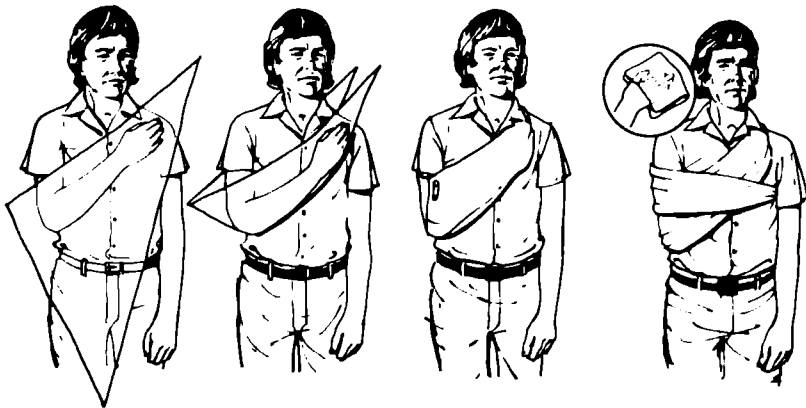
This is normally caused by a fall on the outstretched hand or on the point of the shoulder. The patient cannot raise his arm above the shoulder, normally supports it at the elbow and inclines his head to the injured side to reduce muscle tension.

Fold two triangular bandages narrow. Pass each through an armpit, encircle the same shoulder and tie behind in a reef knot. Place a pad between the shoulder blades. Tie the free ends of the two bandages together or tie the bandages together with a third bandage. Place the arm on the injured side in a sling.



Rib fracture

Collar-bone fracture



Arm fracture – triangular sling

Fractured finger

Arm fracture

If the upper arm is broken and the elbow is not involved, place the forearm across the chest so that the fingers touch the other armpit, place a pad between arm and chest, and place the arm in a sling.

If the hand, wrist or lower end of the forearm is fractured and the elbow is not involved, place the arm in a sling and secure the upper arm to the chest with a broad bandage over the sling.

If the elbow cannot be flexed, lay the patient down, place his arm against his side, palm to thigh, and secure the arm to the body with broad bandages around the upper arm and trunk, around the forearm and trunk, and around the wrist and thighs.

Leg fracture

Support the injured leg. Bring the sound leg to the side of the injured one. Place pads between the thighs, knees and ankles. If no splints are available, bandage the legs together with three broad bandages, one around the legs, one around the thighs, and another below the site of the fracture. If splints are available place a padded splint between the legs from crutch to foot and secure it with five bandages.

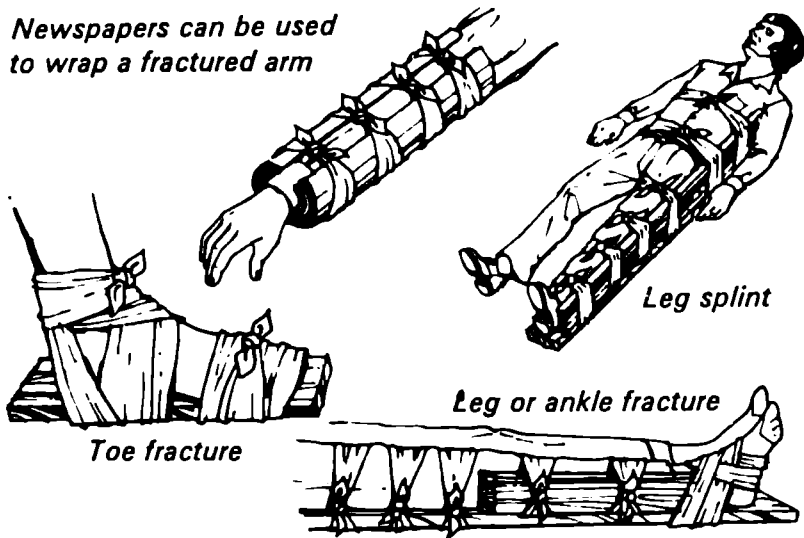


Arm sling

*Fracture of
the humerus*

Fractured hand

*Newspapers can be used
to wrap a fractured arm*



Further fracture treatment

Standard first aid manuals are written on the assumption that first aid is given to sustain life until the patient is taken to a doctor, but survival situations may be prolonged and there may be little chance of getting a survivor to a doctor. The American Department of the Air Force offers this advice for the treatment of fractures in extreme survival situations:

The treatment of fractures is normally considered beyond the scope of first aid; however, in the prolonged survival situation, the correction of bone deformities is necessary to hasten healing and to obtain the result that will allow the injured party to use the injured member. The best time for manipulation of a fracture is in the period immediately following the injury, before painful muscle spasm sets in. Traction should be applied until overriding fragments of bone are brought into line (check by comparing with other limb). Then firmly immobilise the extremity.

An immobilisation device must be improvised. This may be done by weaving together willow branches or other stable items to form a 'splint-cast'.

Gentle but firm traction is also applied to extremities to reduce dislocations.

If you are alone, the problem of treating fractures or dislocations is more complicated but not impossible, for traction can be applied by using gravity. The wrist or ankle end of the extremity can be tied to (or wedged into) a fork of a tree or similar point of firm fixation. The weight of the body is then allowed to exert the necessary counter-traction with the joint being manipulated until the dislocation (or fracture) is treated. Before beginning the procedure, necessary splinting materials must be collected and be readily available.

Strains and sprains

A strain occurs when a muscle is over-stretched. A sprain occurs when ligaments and tissues connected with a joint are wrenched or torn.

To treat a strain, make the patient comfortable and support the injured part.

To treat a sprain, support the joint in the position most comfortable to the patient, expose the joint, and either apply a cold compress or apply pressure by firmly bandaging on a layer of cotton wool.

Blisters

If blisters must be opened, wash with soap and warm water, sterilise a needle over open flame, puncture the blister at the edge, gently press out the water or blood with a sterile pad, then apply a sterile adhesive band or dressing.

Boils

Treat with hot salt applications to draw them to a head. Use sterile gauze to wipe off the discharge. Apply a sterile pad and bandage. Do not squeeze boils.

Infections

To prevent infection, cut away the clothing above a wound. Don't touch the wound with your fingers or with dirty objects. And don't forget: don't suck any wound. Apply a sterile

dressing and bandage firmly. Rest the wounded part. If you have iodine, use it only to sterilise the skin around the wound. Don't pour it directly on an open wound. Let the iodine dry in the air before applying a bandage.

Burns and scalds

There are two types of burns and scalds, the superficial in which only the outer layers of skin are damaged, and the deep in which all skin and nerve endings are destroyed. The superficial burn is the more painful.

Burns are caused by dry heat, electricity, friction, corrosive chemicals and radiation. Scalds are caused by moist heat.

Burns and scalds may cause severe pain, shock and infection. They may also be associated with loss of body fluids and salts. The aim of treatment is to reduce the local effects of heat, relieve pain, prevent infection, and to replace fluid loss and so reduce shock.

The skin and clothing around burns and scalds is normally sterile. Keep it sterile. Don't touch it with your fingers or other unsterilised material. If water is available, either place the burnt part under slowly running water, or dip it in cold water for 10 minutes to reduce the heat. Then cover it with a clean dressing. If water is not available, simply cover the burn with a clean dressing and bandage firmly. Immobilise or rest a badly burnt limb. Give the patient plenty to drink so that the body replaces its fluids. Don't apply lotions, oils or ointments. Don't prick blisters, breathe or cough over burns.

Remember that large amounts of fluid may leak through a burn and that this must be replaced. Give the patient plenty to drink.

Clothing on fire

If a person's clothing catches fire, extinguish the flames by wrapping him in a rug, blanket or coat, preferably wool—never of nylon or flammable synthetics—and have him roll on the ground to smother the fire. If you are alone and your clothing catches fire, roll on the ground and smother the flames, preferably with a wrap.

Sunburn

The skin becomes hot, red and itchy as exposure to the sun dilates the blood vessels in the skin. The severity may be greater in ice, snow or desert areas because of ultraviolet radiation. The skin may swell and blister. A condition popularly known as sunstroke may also develop. Its symptoms include headaches, dizziness, a strong and rapid pulse, high temperature and possibly unconsciousness.

Put the patient in the shade. Give him a cold drink. Apply cold water, cold cloths or icebags to the reddened skin. Apply a sunburn lotion or cream, if you have one.

Heat exhaustion

This comes more slowly and is common in people who are unused to a hot, humid climate. It is caused by exposure to excessive heat and salt and water deficiency which may cause muscular cramps. The face becomes pale and cold, the pulse rapid, the temperature too high or too low. There may be headaches, dizziness, nausea or fainting.

Keep the patient cool. Give him plenty to drink. Add a half-teaspoon of common salt to each 500 ml of water.

Effects of cold

A person may be exhausted by cold as well as by heat. The onset is insidious. The body's heat-regulating mechanism fails and the body temperature declines. The condition is exacerbated by exposure to snow, wind and rain and by physical fatigue and anxiety. The signs include slowness of physical and mental responses; stumbling, cramps and shivering; slurred speech and blurred vision; and irrational behaviour.

A person experiencing these effects of cold should take shelter, keep warm, and rest. If he doesn't, the cold will overcome his heat-regulating mechanism, he will fall asleep from exhaustion, his temperature will fall, his pulse rate will slow down, and he will die when his body temperature falls to about 20°C.

Hypothermia

This results from the lowering of body temperature to a dangerous level. Causes may include prolonged immersion in cold water or prolonged exposure in cold weather. The patient feels cold and begins to shiver. The shivering becomes intense and uncontrollable. The shivering decreases, the muscles stiffen, and movement becomes erratic. Exposed skin may turn blue. The patient's thinking becomes fuzzy. He then becomes irrational and goes into a stupor. The patient becomes deathly cold to touch. His pulse becomes slow, weak, or even imperceptible. His breathing is slow and shallow.

Further heat loss must be prevented. The body must be warmed *gradually* and the circulation of the blood improved. Wrap the patient in warm blankets or clothing. If he is conscious, give him *warm* drinks. Don't heat him rapidly as this may dilate his superficial blood vessels suddenly, taking blood away from the deep tissues and vital organs. If this occurs, he may die as the body temperature and blood pressure declines to a fatal level.

Frostbite

This commonly occurs in the ears, nose, chin, fingers or toes if they are exposed for a long time to cold winds. The skin may go greyish-white and the affected part becomes numb. Severe cases left untreated may result in gangrene.

Get the patient to shelter. Keep him warm. Give him warm drinks. Remove gloves, rings, boots or anything else that might restrict circulation. Thaw the affected part. Frostbitten fingers may be warmed under clothing in his armpits. Frostbitten toes may be warmed against another body, or in a blanket or sleeping bag. Don't rub the affected part. Don't apply direct heat to it. Never forcibly remove frozen shoes or mittens. Don't try to thaw a frozen part by exercising.

Stings and bites

If stung by a bee, hornet or wasp, remove the sting if you can see it by scraping it off from the side rather than by

pinching it. If you have a needle, sterilise it first by passing it through a flame. Antihistamine creams, weak ammonia solution or a bicarbonate of soda solution may help to relieve the pain.

If bitten by a snake, remember that not all snakes are poisonous and not all snakebites are fatal. Many people have died from the fright rather than the bite. Remember that even if the snake has bitten you, it may not have injected its venom. Nevertheless it is wise to treat all snakebites as potentially dangerous and in most cases you will be treating a limb. At least 95 per cent of all snakebites occur on a limb and most occur on the lower limbs. Recent research has shown that very little venom reaches the bloodstream if *firm pressure is applied over the bitten area and the limb is immobilised*.

The symptoms may include immediate pain, swelling, and possibly a purple colour around the fang puncture points. The breath may become short and weak, the pulse rapid and weak. The victim may vomit or faint. But in some cases of snakebite there may be little immediate effect, although paralysis of the jaw muscles, lip, tongue, eyelids, chest and diaphragm may occur later.

- Keep the victim at rest lying down. DO NOT PERMIT HIM TO WALK OR TO RUN AROUND.
- Immediately apply a broad pressure bandage firmly over the site of the bite, then extend the bandaging by rolling the bandage firmly around as much of the limb as possible. Don't remove trousers or jeans as the movement will help the venom to enter the bloodstream.
- Leave the bandage in place until full medical facilities are reached.
- Immobilise the affected limb with a splint.
- Reassure the victim.
- If possible, transport without panic to the nearest hospital, preferably on a stretcher.
- Observe airway and breathing during treatment. Should breathing begin to fail, give artificial respiration.

- Alert the hospital of the impending arrival of the victim as urgent treatment may be required on arrival.
- Do not incise or excise the bite site.
- Bites to the trunk. If possible, apply firm pressure over the bitten area. Do not restrict chest movement.
- Bites to the head or neck. No first aid for bitten area.

Incision and suction are no longer used to treat snakebites. Nor is the use of an arterial tourniquet recommended any longer for any type of bite or sting. The pressure-immobilisation method outlined above is now recommended for treating bites by the Sydney funnel-web spider, the blue-ringed octopus and cone shellfish. Prolonged artificial respiration may be needed after a bite by the blue-ringed octopus if first aid has been delayed. The pressure-immobilisation method should also be used if a person is ill after the removal of a bush tick. No first aid is recommended for bites by the red-back spider as the venom works very slowly. If the movement of the venom is restricted pain around the site of the bite may become very severe.

Road accidents

One of the most common types of survival situation encountered by the average person is the road accident. What should you do if you are the first on the scene at a road accident? The Tasmanian Civil Defence and Emergency Services Organisation gives this advice:

The first instinct is to run to the car and start pulling people out. DON'T!! It has been discovered that 'A high percentage of the people hurt in cars and pulled out by frantic rescuers are made worse, even killed'—and this is fact.

Here in summary is its advice about what to do:

- Don't panic
- Protect the scene
- Call the nearest police station (metropolitan areas dial 000)

- Stop the bleeding
- Don't turn or move casualties

Here in more detail is what to do first. Park your car at a slight angle, with the front of the car pointing to the centre of the road, far enough away from the scene to warn other drivers of the accident. Check on the number of people trapped or injured. Stop passing cars and send them in opposite directions to find telephones. In metropolitan areas DIAL 000 and ask the operator for the police; outside metropolitan areas see directory for emergency numbers; give all available information re extent of crash, exact location, the number of injured, the number and types of vehicles involved and the services required.

To further protect the scene flag down more cars and get the drivers to pull off the road. Send one in each direction to act as a flagman—wave a white object about 200 metres from the scene of the accident.

As soon as you get to the crashed vehicles turn off the ignition and lights to prevent fire. If the victims of the crash are hurt but not bleeding profusely, leave them in the car(s) until trained help comes. **DON'T TWIST, TURN OR MOVE THEM.** If they are lying on the road, cover them with a blanket or coat, leave them there and take steps to guard them from the traffic.

Often accident victims otherwise unhurt appear to be trapped when they are merely held by a foot twisted under a seat. If so crawl in and gently release the foot.

When a fire does not start right away it rarely starts afterwards. Fire in the wiring usually begins as smouldering under the bonnet or dashboard. Do three things: (1) disconnect the battery, (2) locate the fire, (3) attack it with a fire extinguisher, blanket or earth.

The Commonwealth Department of Transport has given the following advice for rendering first aid at a traffic accident (see its pamphlet, *Accident action*).

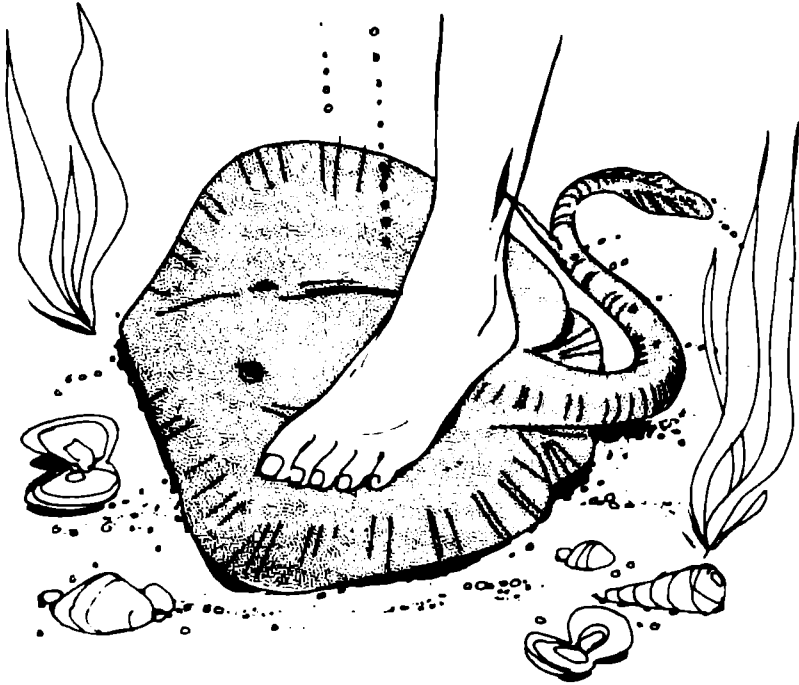
Don't stand by and let him die

Ask yourself: Has more than one person been hurt? Who needs help first? Look after the unconscious person first. Is he breathing?

If yes, ensure airway is clear.

If no, ensure airway is clear and restart his breathing by mouth-to-mouth resuscitation.

Stop bleeding by applying direct pressure over the wound.



Stingray (p. 173)

Survivors in and around Australia are more likely to be bothered by flies, ants, mosquitoes and fleas than by dangerous and venomous animals, but Australia does have its share of creatures which are dangerous to man. On land there are snakes, spiders, scorpions and ticks. In the sea there are sharks, octopus, poisonous fish, box jellyfish, cone shellfish and venomous sea snakes. But most of our venomous animals are shy and only a few Australians die each year from the effects of venomous bites and stings. The purpose of this chapter is to describe some of our venomous animals and to suggest ways of dealing with injuries they inflict.

Snakes

Relatively few of Australia's venomous snakes are potentially dangerous to humans, and none of its lizards is venomous, so that a survivor can assume that any reptile with legs is harmless. Generally, snakes are shy. When they can get food they hide and stay clear of human beings. They are normally encountered when they are searching for food. Most snakes attack only when they can't escape or when they are attacked deliberately or inadvertently by a person.

Snakes move at about the pace of a human being walking. They normally feed only in warm weather. They kill other animals either by biting them or by gripping them with their whole body. Most of the venomous snakes bite.

Typically a venomous snake secretes a dangerous fluid in its venom gland. When it bites it squeezes the venom from the gland along a duct to the base of each channelled or grooved fang. As the fangs press into the tissues of the

victim the venom is squeezed through the groove or canal into the tissues.

Venoms differ from snake to snake but the four main constituents of most venoms are: neurotoxins which block communication between nerve ends and muscles and cause paralysis; haemorrhagin which causes bleeding by breaking down blood vessel walls; haemolysin which destroys blood cells; and thrombase, a blood coagulant.

When a snake bites it leaves two or more punctures caused by the fangs and the reserve fangs. In some cases it is easy to see the punctures; in others it is difficult. Some bites cause little or no reaction around the punctures; some cause bleeding, slight swelling or bruising. Generally, however, the victim experiences little immediate effect except the swift, sharp pain of the fangs penetrating his tissues. The effects of the venom may not be experienced for 15 minutes or even several hours, depending on the health of the victim, the kind of snake, and the type and amount of venom injected. In most cases the first obvious effect is paralysis of the muscles of jaw, lip, tongue and eyelids, then of the chest and diaphragm. Breathing may become difficult and the urine may become red or black. The victim may experience headache, nausea, vomiting, sweating, diarrhoea, faintness, blurred vision, drowsiness and unconsciousness.

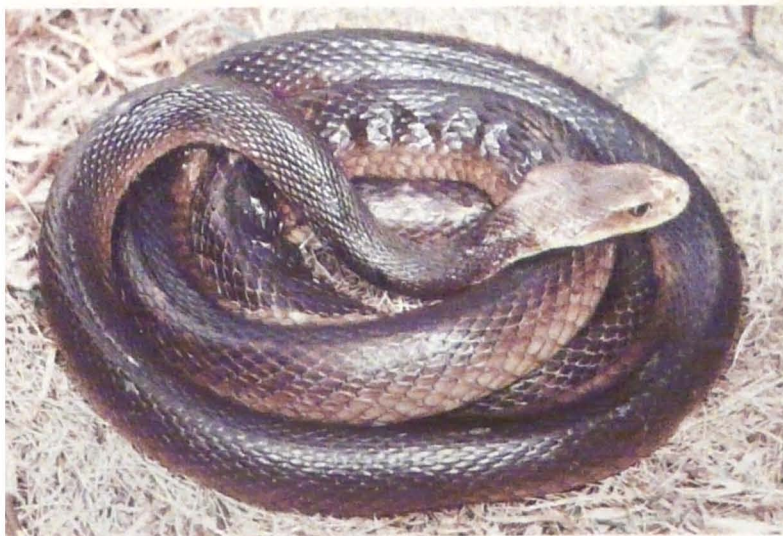
The Head of Immunology Research, Commonwealth Serum Laboratories, Melbourne, Dr Struan K. Sutherland, has said that possibly 3000 persons are bitten by snakes in Australia each year and more than 300 are treated with antivenom. 'Ten deaths occurred during the 12 months to December 1978,' he said in an article in *Australian Prescriber* (vol. 3, no. 4), 'and many patients suffered a devastating illness due to delayed or inadequate antivenom usage. In perhaps 70 per cent of cases, especially when small snakes are involved, little venom is injected and no significant evidence of envenomation develops. Obvious clinical or laboratory evidence of poisoning is usually evident within 2 hours of the bite being inflicted or of abandoning effective first aid measures if the snake has introduced a significant amount of venom.'



Tiger snake
Notechis scutatus



Taipan
Oxyuranus scutellatus



H. G. Cogger

H. G. Cogger



Death adder
Acanthophis antarcticus



Red-bellied black snake
Pseudechis porphyriacus



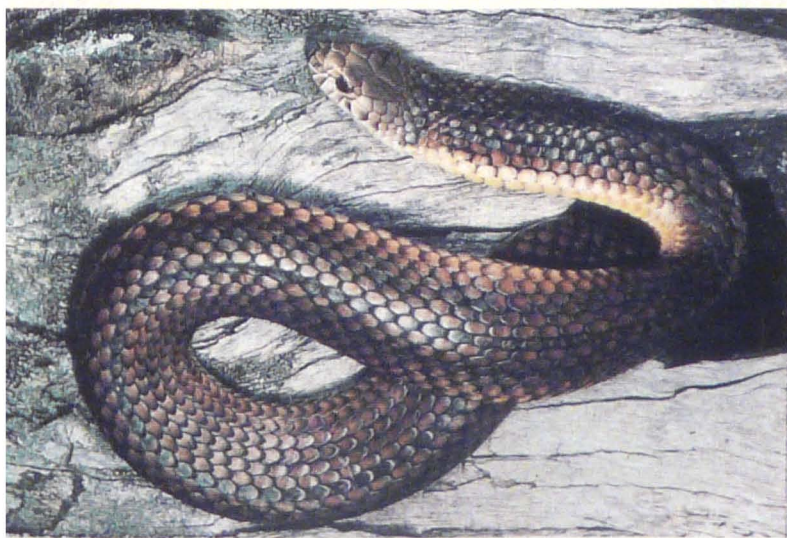
H. G. Cogger



Eastern brown snake
Pseudonaja textilis



Copperhead
Austrelaps superbus



H. G. Cogger



Yellow-bellied sea snake
Pelamis platurus

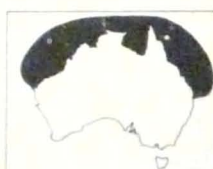


Rough-scaled snake
Tropidechis carinatus

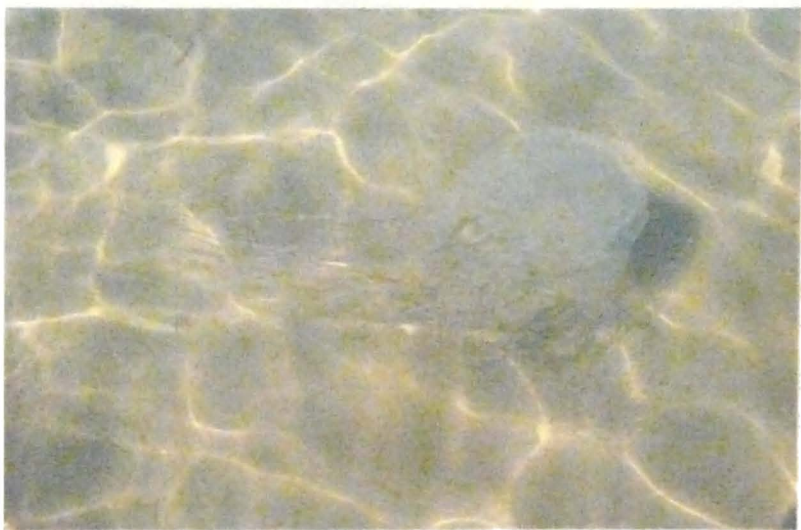




Blue-ringed octopus
Photographic Library of Australia



Box jellyfish (sea wasp)
Photographic Library of Australia





Stonefish

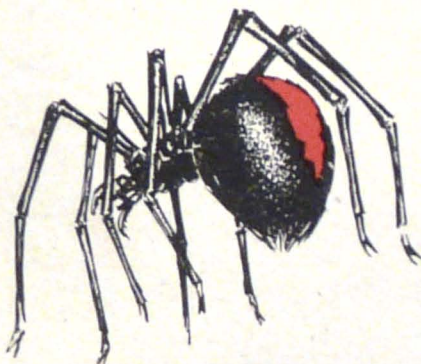
(top) John Carnemolla--Australian Picture Library
(bottom) Photographic Library of Australia



Cone shellfish

(top) Bill Wood - Australian Picture Library
 (bottom) RAN School of Underwater Medicine





Red-back and habitat



Funnel-web and habitat



Female



There are two ways of treating snakebite. One is with first aid, the other with an antivenom. The first thing to do is to remove the snake. Kill it if this can be done quickly and safely as positive identification will help in selecting the appropriate antivenom. The recommended first aid treatment is set out on page 149, but for convenience is repeated here :

- Keep the victim at rest lying down. **DO NOT PERMIT HIM TO WALK OR TO RUN AROUND.**
- Immediately apply a broad pressure bandage firmly over the site of the bite, then extend the bandaging by rolling the bandage firmly around as much of the limb as possible. Don't remove trousers or jeans as the movement will help the venom to enter the bloodstream.
- Leave the bandage in place until full medical facilities are reached.
- Immobilise the affected limb with a splint.
- Reassure the victim.
- If possible, transport without panic to the nearest hospital, preferably on a stretcher.
- Observe airway and breathing during treatment. Should breathing begin to fail, give artificial respiration.
- Alert the hospital of the impending arrival of the victim as urgent treatment may be required on arrival.
- Do not incise or excise the bite site.
- Bites to the trunk. If possible, apply firm pressure over the bitten area. Do not restrict chest movement.
- Bites to the head or neck. No first aid for bitten area.

If you can get the victim to a hospital, he may be given an antivenom. If, as in rare cases, the snake can be positively identified, the victim will be given the appropriate monovalent antivenom. If it can't, he will be given a polyvalent antivenom, or, in Tasmania, a tiger snake antivenom, or, in Victoria, tiger snake and brown snake antivenoms.

Positive identification of a snake is normally difficult in snakebite situations but a knowledge of the distribution of the

main venomous snakes helps narrow the possibilities. Tasmania has only two deadly species, the tiger snake and copperhead. Victoria has the brown snake, tiger snake, copperhead, red-bellied black snake and mulga or king brown snake. These five are also found in New South Wales, where the gwardar and death adder are also found. South Australia has all of these and Queensland all except the copperhead, and it also has the taipan. The small-scaled or fierce snake, which has a venom even more potent than that of the taipan, is found in central Australia in a large area around the 'corner' where the borders of the Northern Territory, South Australia, Queensland and New South Wales meet. A desert form of the death adder is found in Central Australia and the Northern Territory. The mulga snake, gwardar and taipan are also found in the Territory as well as a whip snake commonly known as the spotted-headed snake (which is sometimes found in Queensland). The tiger snake of eastern Australia is not found in Western Australia, but a geographical variety known as *Notechis ater occidentalis* is. The State also has the gwardar, the mulga snake, desert death adder and the dugite or spotted brown snake. Knowledge of this distribution helps doctors to choose appropriate antivenoms. A doctor in Tasmania would inject intravenously a tiger snake antivenom knowing that it would be effective whether the biter was a tiger snake or copperhead. In New South Wales a doctor would use a polyvalent antivenom, knowing that it would neutralise the venom of the seven deadly species. Thus choice of an antivenom is governed by knowledge of the distribution of species, by the toxicity of venoms, and the average dose of venom that a particular species might be expected to inject during a bite. The longer the time between the bite and the antivenom infusion, the greater the quantity of antivenom required. Because their bodies are generally smaller, children may become critically ill more quickly after a bite than adults and therefore may need at least double the recommended quantity of the initial dose.

Dr Sutherland has said: 'Due to a combination of the large quantity produced and the high toxicity of Australian

snake venoms, the major Australian snakes are without a doubt the most dangerous in the world.'

The taipan is Australia's biggest and most venomous snake. The venom of some populations of tiger snakes and that of the fierce snake is more potent than that of the taipan, but the taipan can carry much more venom. It may grow to a length of 3.5 metres, although 2–3 metres is normal. It is found mainly in northern Australia. It is normally brown on top with a lighter, sometimes creamy-yellow, belly freckled with reddish pink. The front of the body is slender, the head long. When biting it sometimes snaps several times before taking hold. The effects of its bite are comparatively swift and extremely distressing. Few people recovered from taipan bites before the development of a taipan antivenom in 1955.

Tiger snakes are widely distributed. They are found in the Brisbane region, across the south-eastern corner of Australia, and around Adelaide and the Gulf region of South Australia. They may be yellow-orange, brown, grey or olive and many are striped creamy-yellow. They are normally about 1.5 metres long. They hunt by day and sometimes on warm summer nights. The Western Australian tiger snake is steel blue to brown and has yellowish cross-bands. A separate species of tiger snake which grows to 2.5 metres in length is found on the islands in Bass Strait.

The most common death adder in Australia is grey to red in colour, with darker bands, and its thick body is normally from 0.6 to 1 metre long. It normally lies coiled in the sand or dust with its head close to the lower part of its body and merges so well with its environment that it is difficult to see. It uses a grub-like spine on the tip of its tail as a bait for its animal prey and despite its lethargic appearance strikes rapidly.

The red-bellied black snake is purplish-black on top and red or orange underneath. It may grow to more than 2 metres in length. It will sometimes feint rather than strike but there have been many accounts of actual bites. Its bite would probably not kill a man but it could kill a child.

The coppery mulga snake normally grows to about 2 metres but some attain 3 metres in length. It is more aggressive than its cousin, the common black, and carries much venom. It is very dangerous and its bites should be treated immediately.

The common brown snake is normally brown but may also occur in such shades as grey and pink, or, when young, be fully or partly banded. It grows to over 2 metres in length and may strike several times when attacked.

The copperhead is normally coppery brown but some are rather darker. It has barred lip scales and some have a dark collar bordered by yellow with a dark stripe down the back. Most grow to 1–1.5 metres in length. As it has small fangs, it is believed to be able to inject only a comparatively small amount of venom, but the venom is potent.

The best way to avoid snakebite is to avoid snakes. Don't attempt to catch or kill them. Don't put your hand down a rabbit burrow or up a hollow log. Don't walk barefooted at night in death adder country. If you are walking in country known to be infested with snakes, wear leggings or tough, heavy trousers. If you have to kill a snake, use a long, heavy weapon and give yourself plenty of room to move. Remember that not everything that looks like a snake is venomous, nor are all snakes venomous. Lizards have legs, although the legs of some lizards are not easy to see. They also have obvious tails, normally as long as their body or longer, whereas the tails of snakes are shorter and are more difficult to recognise as they are continuous with the body. Most lizards have movable eyelids; snakes have none. Lizards also have a small ear opening in their head and a one-piece jaw, whereas the snake has a two-piece jaw—not that this will be noticed by the casual observer.

Spiders

Australia has two deadly spiders, the red-back and the funnel-web.

The red-back is normally found in the shade in a place where air currents will carry flies, slaters or beetles into its

ragged web. Common haunts for red-backs are sheds, rubbish dumps, old tins and under bushes.

The female is about three times as big as the harmless male. It has a satin-black body, long slender legs, and a broad longitudinal stripe on its abdomen. This stripe is normally a brilliant red, but may be pink, orange or even off-white.

The red-back injects her venom into her prey through a channel in her fangs. The bite may cause a sharp sting or may not be felt at all. Redness and swelling may develop at the site of the bite. There may be localised burning pain and sweating which gradually increases and becomes generalised. Shivering and muscular weakness may develop. A rash may appear during convalescence and shooting pains may occur for a considerable time after the bite. A red-back bite rarely kills an adult but may kill children. The effects will vary with the amount of venom injected, the nature of the tissues around the bite, and the size and health of the person bitten.

The best treatment for a red-back bite is an injection of the antivenom developed by the Commonwealth Serum Laboratories but in a survival situation this would probably not be available. Nowadays no first aid is recommended as delaying the movement of the venom increases pain at the bite. Try to capture the spider if you are seeking medical aid, or at least get a reasonably accurate description of it.

A funnel-web spider bite can cause death in 90 minutes, according to Dr Struan Sutherland of the Commonwealth Serum Laboratories, and some children have died in 15 minutes. No effective antivenom was produced until 1980. Then the CSL announced that they had developed one which showed encouraging results when tested on monkeys. One problem in developing an antivenom program was the scarcity of venom. The CSL appealed for hundreds of spiders because although its own were milked each week, they produced only 180 micrograms each.

The Sydney funnel-web, *Atrax robustus*, is found mainly around Sydney, particularly in sandstone crevices and crannies. It is a large, hairy creature with a heavy body (about 25 mm in length) and relatively short legs. It prefers a cool,

moist environment and hunts at night. It spins a web with a deep horizontal tube or funnel in it. Both males and females can deliver a lethal bite, although it would seem that the male is deadlier than the female. Certainly it is more often encountered by human beings as it roams widely during the mating season. Its long fangs inject venom in much the same way as do a snake's and they may even penetrate clothing and tough skin, leaving a double puncture wound not unlike a snake's.

The bite is normally very painful. The sharp pain at the site soon extends to other parts of the body. Sweating, delirium and respiratory failure follow a bite. Both children and adults have died from funnel-web bites.

Treatment is the pressure-immobilisation method for snakebite detailed on pages 149 and 163 and summarised here: immobilise the person and the limb; immediately apply a firm broad roller bandage to the bite area, then to the whole limb, and then apply a splint; keep the victim immobilised until he receives medical treatment.

Scorpions

Scorpion bites are comparatively rare and no Australians are known to have died from them. A scorpion has two large claw-like pedipalps near its mouth. Its venomous sting is at the tip of its flexible, segmented tail. It uses its claws to grasp and crush its prey and swings its tail up and over its back to force its sting into its victim. The sting is very painful. It numbs the site of the sting and, if enough venom is injected, the numbness extends to other parts of the body. The normal treatment is with analgesics, rest, and hot compresses.

Ticks

The tick which most often attaches itself to human beings is the scrub tick, which is normally found east of the Great Dividing Range. It is a small blood-sucking animal which attaches itself to a body and engorges itself with blood, swelling to several times its original size. With its head buried in human flesh, it can spread its toxic salivary secretions

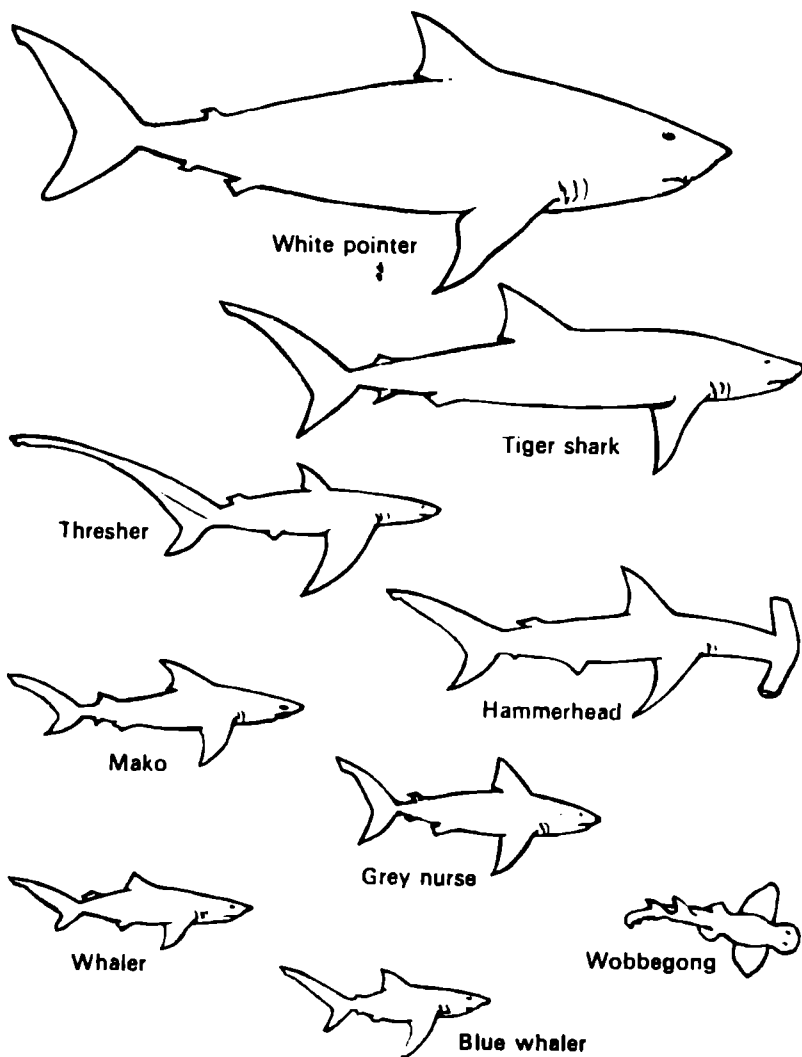
causing local anaesthesia, then more generalised toxæmia and paralysis. People who are hypersensitive to tick salivary proteins may suffer a severe allergic reaction. A tick should not be pulled off, as this will remove the body, not the head which spreads the toxic secretions. The result will be a painful swelling until the head is removed or discharged. A tick is best removed by dousing it in turpentine or chloroform. If the victim is already ill, the pressure-immobilisation technique should be used if possible to inhibit the movement of any toxic saliva expressed while the tick is being removed.

Sharks

About a hundred shark attacks occur each year throughout the world and about half of these are fatal. Most Australian attacks occur on the east coast in water above 20°C and it is believed that the whaler is responsible for most of them. The whaler grows to 5 metres in length and is often found close to the shore and in estuaries and freshwater inlets. Other dangerous sharks in Australian waters include the white pointer, which may grow to 12 metres, the bluish mako (5 metres), the mottled tiger shark (10 metres), the blue whaler (5 metres), the grey nurse (3 metres), and the hammer-head (7 metres). The thresher and the wobbegong or carpet shark are regarded as harmless, although the carpet shark may be goaded into action. On the Great Barrier Reef divers encounter the grey reef shark or bronze whaler (2 metres), the silver tip reef shark (4 metres), the black tip reef shark (2 metres), and the white tip reef shark.

Sharks often attack from below and sometimes make several attacks on a victim. They sometimes circle him before attacking and often brush him with their abrasive skin before moving in to bite. A shark bite usually causes an extensive, ragged wound, often comprising multiple crescent-shaped cuts. Large areas of tissue are damaged and bleeding is severe. Shark teeth, damaged tissue and fragments of bone may be found in the wound and it may be contaminated with bacteria, including a paracolon bacillus resistant to penicillin.

As explained in Chapter 11 on survival at sea, survivors threatened by sharks should bunch together in a tight circle facing outward and try to ward off an attack by kicking or stiff-arming the shark. Any contact with its rasp-like skin,



however, will cause brush wounds, so hitting a shark is a last resort.

If you are swimming alone, use strong, regular strokes and do as little as possible to attract the shark's attention. Wear dark protective clothing if possible. Don't urinate or defecate in the water. Don't carry fish and try to stop any blood getting into the water. Body wastes, dead fish and blood are believed to attract sharks. Bubble curtains, explosives, sound and ultrasonic waves, electrical and chemical repellents have all been used as defences against sharks but experienced divers say that they inspire more confidence than they offer protection.

To treat a patient who has been bitten, remove him from the water if possible. Control the bleeding by hand pressure, tourniquet or bandages. Ensure that he lies comfortably, head lowermost, and reassure him. Get medical help if available.

Other dangerous marine animals that bite and are found in Australian waters include the barracuda, the reef eel, the groper, and the killer whale. Most of the advice given on preventing shark attacks and treating wounds applies to these too.

Blue-ringed octopus

A bite from this deadly creature is more likely to be the result of ignorance rather than of an attack by the octopus. The blue-ringed octopus may weigh from 10 to 100 grams and, with tentacles expanded, it may measure from 20 to 200 mm. It is yellowish brown and has rings on the tentacles and striations on the body. These markings turn an iridescent blue when the animal is excited. It is found in rock pools around most of the Australian coast and its bright colours are apt to attract attention.

If the octopus is handled, it is likely to bite its handler with its little beak and if it bites, its victim may not even know that he has been bitten. The venom it injects, however, acts swiftly. Death due to respiratory failure may occur quickly. The area around the bite swells during the first 15 minutes,

then becomes a blood blister. If the victim survives the first hour he will feel a sting for 6 hours, will vomit, find breathing difficult, experience speech difficulties, double vision and muscular twitching, and may see a bloody discharge from the wound. Respiratory paralysis may result in unconsciousness then death, or may persist for up to half a day, followed by general weakness for another day and muscular twitching for several weeks.

The pressure-immobilisation technique is recommended. Artificial respiration may have to be administered for hours after a bite if first aid has been delayed.

The best way to avoid a bite from a blue-ringed octopus is to avoid handling the octopus.

Cone shellfish

Some cone shellfish are highly venomous but too little is known about them to be sure about which ones. One theory is that only the fish-eating cones are dangerous, but even if this is true, it is a poor field guide for survivors. The general rule is to avoid contact with cone shells.

The cone shell, which is normally about 100 mm long, lives in shallow waters, reefs, ponds and rubble in both temperate and tropical water. It injects its venom through a tooth or small harpoon which pokes through the proboscis at the narrow end of the shell and which may extend back even to a hand holding the wide end and may also penetrate clothing. The puncture may be painless or cause excruciating pain, depending on the species. Within 10 minutes the whole body may be numb, with the mouth and lips being worst affected. Muscular paralysis may also extend throughout the body. The vision may be blurred and the speech slurred within 10 to 30 minutes of the bite. Respiratory paralysis and possibly cardiac failure may follow for up to 6 hours.

The pressure-immobilisation technique is recommended. Artificial respiration may have to be administered for hours after a bite if first aid has been delayed.

The best way to avoid cone shell bites is to avoid cone shells.

Stingrays

Stingrays are found all around the Australian coast and stings most often result from a person stepping on a ray buried in the sea-bed, or diving over it. The stingray has a tail, and on the tail a spine. The tail flashes up and drives the spine into the victim injecting venom as it does so. The wound may vary from a puncture to a 150 mm cut. It may be aggravated when the serrated spine is extracted. Bleeding may be profuse and pain may last for up to 12 hours. Vomiting, diarrhoea, muscular cramps, tremors, fainting, sweating, difficulty in breathing and cardiac irregularities may result.

To treat a stingray wound, lay the patient down, raise the limb, reassure the patient, wash the wound, extract the spine, stimulate minor bleeding, immerse the wound in hot water (50°C) until the pain has stopped (30–90 minutes), and apply a sterile dressing, such as an unused newspaper.

To avoid stingrays, shuffle your feet when walking in water so that the animal has time to get out of your way. Wearing boots may also provide some protection, although the spine can penetrate boots.

Stonefish

The stonefish looks like a stone. This provides it with effective camouflage as it lies in mud or on rocks or reefs. It grows to 300 mm in length and has thirteen dorsal spines, each supplied with venom by two glands. Injury typically results from stepping on the fish in the belief that it is a rock or piece of coral. If you do, the stonefish's spines penetrate your foot and it injects its powerful venom. Pain is immediate and excruciating. It may cause unconsciousness, and thus drowning. The affected area may swell, adjacent muscles may be paralysed, and pain and inflammation may last for many days. Effects may include respiratory failure, pallor, sweating, fever, delirium and generalised paralysis. Convalescence may take months.

First aid begins with rescuing the patient from the water. Do not try to restrict the movement of the injected toxin.

Most stings respond to bathing in warm water but pain may have to be relieved by local or even general anaesthesia. A stonefish antivenom is available.

Jellyfish

These belong to a phylum of animals known as the coelenterates which develop stinging capsules called nematocysts. Jellyfish generally consist of a stomach surrounded by tentacles. The tentacles contain the nematocysts, which either stick to the animal's prey or penetrate it like a needle, discharging venom into it. Among the many jellyfish which sting Australians are the blubber jellyfish, the sea blubber or hairy stinger, sea lice, jimble, the mauve stinger, the Portuguese man-o'-war or bluebottle, and the deadliest of all, the sea wasp or box jellyfish (*Chironex fleckeri*).

Each produces a characteristic sting pattern. The nematocysts of the mauve stinger normally produce two to four short red lines when they touch the human body. The Portuguese man-o'-war normally produces a single long strap with small blisters along it. The box jellyfish produces multiple long red lines.

The box jellyfish is one of the biggest and certainly the most dangerous of the jellyfish. It is said to be the most venomous of all marine animals. The box-shaped bell of some specimens is up to 200 mm long and weighs 2–3 kg. It is about as big as a man's head. At the bottom of the bell are four pedalia, which resemble hands, and from them hang up to sixty strap-like tentacles loaded with millions of nematocysts. These invisible strands may extend for more than 8 metres in the water, but 3 metres is more common.

Box jellyfish are found in northern Australia, normally between October and March. When they are found close to shore the weather is usually calm and there are usually more of them about on a rising tide.

When the tentacles come into contact with a human body they stick to it and the thin-walled nematocysts discharge their venom into the victim's skin, leaving multiple interlacing

weals of red, purple or brown, the scars of which may remain for years. The victim experiences excruciating pain on first contact and usually claws at the tentacles sticking to him. He may lose consciousness and drown or he may die within 10 minutes of contact. The effect varies from person to person and according to the nature and place of the contact and possibly the amount of venom injected.

If the victim survives, he will experience great pain for up to 12 hours and a range of cardiovascular effects. Psychological effects may last for months.

The first thing to do in the case of box jellyfish sting is to prevent drowning. Then pour domestic vinegar (never methylated spirit or alcohol) over the adhering tentacles to inactivate them as soon as possible. Neither an arterial tourniquet nor the pressure-immobilisation method is recommended. An antivenom is available. Artificial respiration and external cardiac massage may be needed, especially if the patient has stopped breathing or if the skin or lips are blue.

Other marine animals

This section has dealt largely with the most dangerous or the most frequently encountered venomous marine animals in Australian waters. There are others, notably animals that sting. These include the bearded ghoul, the bullrout, butterfly cod, catfish fortescue, frogfish, goblinfish, old wife, rabbitfish, ratfish, red rock cod, South Australian cobbler and surgeonfish. There are also sea snakes which are said to be venomous, but little is known about them and they seem not to have been a great hazard for swimmers or survivors.

To avoid dangerous marine animals, here are some simple rules. Wear shoes when walking on reefs. Shuffle your feet in the sand to allow creatures such as the stingray to get out of your way before you get in his. Don't put your hands into dark holes—probe with a stick. Don't play with cone shells or the blue-ringed octopus. Don't urinate or defecate in the water when swimming. Don't carry dead fish. Don't dangle limbs from a raft or boat.

Natural disasters

9

BUSHFIRES

Fire can kill people in five ways but in practice only one is important. The five ways are :

1. The body's heat regulation mechanism fails.
2. The body is burnt.
3. The lungs are seared by superheated gases.
4. A person is overcome by smoke and dies of lack of oxygen (anoxia).
5. A person is poisoned by carbon monoxide or other toxic gases.

Dr A. R. King of the CSIRO has shown that most people who die in bushfires die because the body's heat regulation mechanism fails. They are dead or nearly dead before the flames touch them. They die of extreme apoplexy or heat stroke caused by excessive radiation. 'By laboratory and field measurement and from the study of case histories of people who have either lost their lives or saved them when encompassed by fire,' Dr King wrote in 1961, 'it is now abundantly clear that the radiated heat is the main peril leading to exhaustion and collapse.'

This finding has been supported by further experimental work done by officers of the Forestry and Timber Bureau. Summarising the results, Mr N. P. Cheney of the Bureau wrote in 1972 :

A number of popular misconceptions—such as death from lack of oxygen if trapped in a fire or that a car petrol tank will explode if exposed to naked flame—cause many persons to panic and sometimes flee a safe refuge.

In grass or forest fires, the main cause of death is heat stroke in an extreme form as a result of excessive heat radiation. Even severe burns to the body are not an immediate cause of death unless accompanied by heat stroke.

Most of the heat felt from a bushfire is radiant heat and though it can reach high intensity it lasts only a relatively short time.

The evidence available suggests that even if the body is badly burnt it is rarely an immediate cause of death unless the heat mechanism has failed. Autopsies on the victims of the Lara fires in Victoria on 8 January 1969 suggest that it is improbable that people caught in a bushfire will be overcome by smoke and suffer from lack of oxygen or have their lungs seared by hot gases. Burns and gases are unlikely to prove fatal by themselves. The danger is that they will make a person act irrationally and expose himself to the one effective killer in a bushfire, excessive radiation.

Heat rays travel in straight lines. They don't penetrate solid materials and they are easily reflected. The best way to protect yourself against radiation is to place a barrier between yourself and the heat rays. Good barriers are opaque materials such as clothing, wood, earth, stones and metal. A motor car and a house can be effective heat barriers in a bushfire. The important thing to remember is that although radiant heat may reach high intensity in a bushfire, it lasts only a short time. Even the flaming period of a forest fire rarely exceeds 4 minutes in any one place. These facts explain most of the growing number of apparently miraculous survivals in Australian bushfires and also the growing number of casualties.

Dr King records the case of an old man who wrapped himself in a wet blanket and stood still when surrounded by a fire. He survived while his comrades, who tried to escape, all perished. He also records the case of a party who were trapped in a forest fire with a bulldozer. The dozer driver dug a shallow trench, covered his comrades with earth, then slid into the trench and covered himself with earth. All survived.

In analysing several Australian bushfires, Mr Cheney shows that survivors escaped largely by protecting themselves from

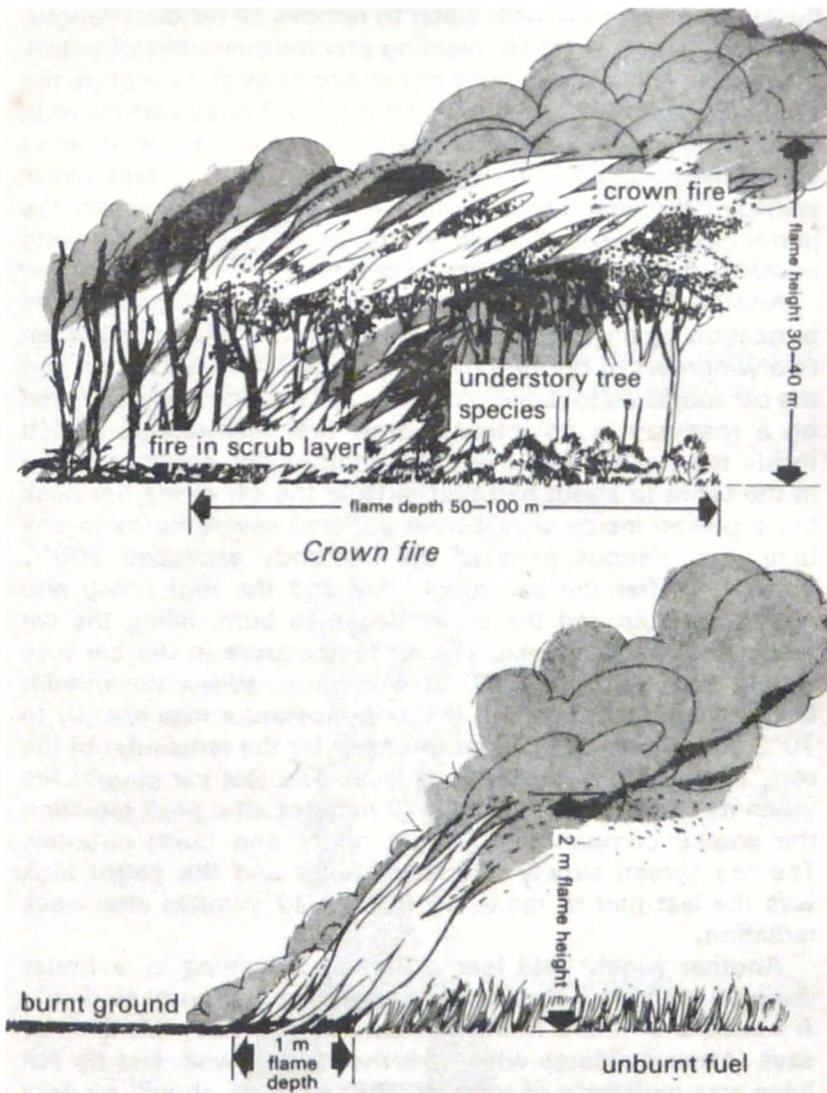
radiant heat and most victims died because they were exposed to it. In the Wandilo fire of April 1958 eleven fire-fighters were trapped in three fire-fighting vehicles on a narrow break. Eight attempted to run back along the break and perished. Two sheltered in the cabin of a truck until it was well alight but the worst of the firestorm was over and one sheltered in a deep wheel rut on the soft sand of the firebreak and placed a coat over his face. All three survived. In the Lara fires of 8 January 1969 seventeen people were killed when they left their cars in a fast-moving grass fire in Victoria. Several others remained in their cars and survived.

Summarising the results of his studies of bushfire survivors, Dr King said :

In all these situations the people lived chiefly because, whether intentionally or otherwise, they succeeded in shielding themselves effectively from the radiation and avoided loading further stress on their bodies by panicking or by running wildly. Had there been too many people to crowd into the cabin of the truck the others could have crawled underneath where they would have been fairly well shielded and where the air would have been relatively cool. Similarly, if trapped in a house, one should close all windows and doors and stay inside. Abandon such places of concealment only when they are burning fiercely and conditions in the hideout are becoming unbearable. By this time, with any luck, the surrounding vegetation will be almost consumed and the flames dying down. You should then be able to walk through them to life and safety on the burn. When the invidious choice must be made, it is better to choose the oven than the griller.

One of the major fears of people sheltering in motor cars is that the petrol tank will explode, but research has shown that the standard petrol tank is difficult to explode. Mr Cheney reports that when a tank contains petrol the space above the liquid always contains a mixture that is too rich in petrol vapour to explode.

'During experiments with a large number of petrol tanks', he writes, 'an explosive mixture could only be obtained after first

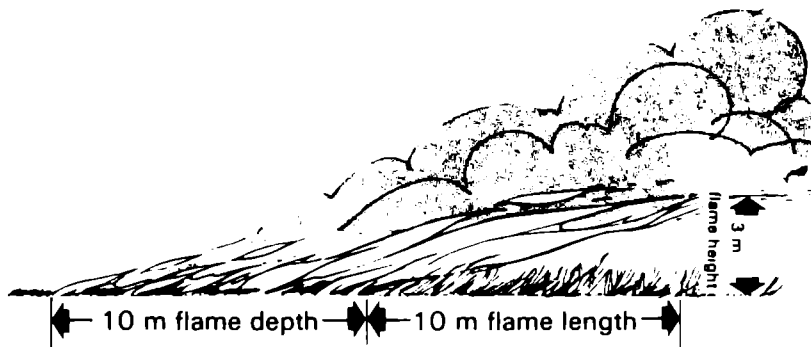


Grass fire burning under low wind speeds of 5–10 km/h. With a fire such as this it would be possible to walk or run through the flames.

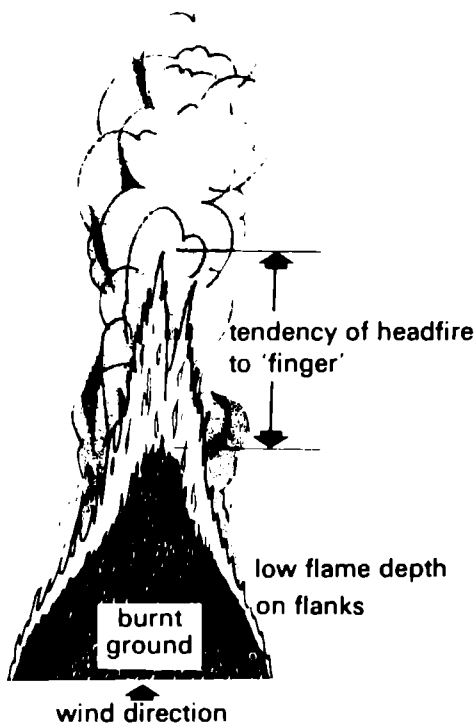
flushing out the tank with water to remove all residual vapour, allowing to dry and then injecting precise quantities of petrol. Even then the explosion was not strong enough to rupture the tank but only distort its shape.' Of the 1200 or so cars burnt in the 1967 southern Tasmania fires none had an exploded petrol tank. However if the tank is ruptured in an accident petrol spillage can cause an 'explosion-like' situation. Normally the petrol gas will expand, blow off the petrol cap and ignite and continue to burn with a blowlamp effect.

Another experiment showed how effective a car could be as protection against radiated heat. A car was placed between two windrows of burning pine slash about 8 metres apart and the car subjected to radiation levels similar to those experienced on a roadway in an intense forest fire. Instruments placed inside the car showed that the windows cut down radiation in the cabin to about half that outside the car at the fire peak but a person inside would have suffered severe burns to any bare skin. Various parts of the car body exceeded 200°C 4 minutes after the car caught fire and the roof lining and rubber seals around the doors began to burn, filling the car with dense black smoke. The air temperature in the car rose slowly from 29°C to 40°C at 4 minutes. When the interior linings began to smoulder, the air temperature rose sharply to 70°C and remained at about this level for the remainder of the test. This was not a hazardous level. The test car caught fire when its tyres ignited. Eight to 10 minutes after peak radiation the engine compartment caught alight and burnt strongly. The fire spread slowly into the interior and the petrol tank was the last part to ignite, more than 30 minutes after peak radiation.

Another widely held fear is that by remaining in a house during a bushfire a person will be trapped and burnt to death. A house is in fact a shield against radiated heat. Mr Cheney says, 'Most buildings which are maintained well, and do not have accumulations of rubbish close to them, should be easy to protect from fire, by carrying out such measures as closing the windows and doors etc. and maintaining a vigilant patrol to put out spot fires as they start. In the worst situation a house



Grass fire spreading under a strong wind (40 km/h) with 3 m high flames, a flame length of 10 m and a flame depth of 10 m or more.



View from above

will provide a refuge from the peak of the fire, even if it burns down later on.' In analysing the Tasmanian fires of February 1967 he shows that over 60 per cent of the houses from which people fled were not burnt and he argues that those who died while fleeing their houses probably would have survived had they remained in them:

Most of the 1300 houses, cottages and shacks destroyed by the fire were vacant or had been abandoned by the occupants in the face of the fire. There were numerous instances where one or two householders had stayed behind and managed to save their own home—and often those abandoned by their adjacent neighbour. There were also several instances of elderly pensioners with dilapidated homes which most fire controllers would rate as a 'death-trap' classification, who not only survived, but also saved their homes because they followed the basic survival rules.

A. G. McArthur has written, 'Without any doubt, the safest place for any family is in their own home. There are few recorded instances of houses being burnt whilst occupied. Generally a house catches alight from burning embers lodging on the roof or in the eaves. It generally takes little effort by the womenfolk or children to put out these spot fires by the use of water or dirt if ladders should be available.'

In his report on the Tasmanian bushfires, Mr McArthur noted that the houses which survived in Hobart fringe developments were those in which people had remained and in which the fire had been fought with garden hoses and wet bags. Those which burnt were unattended. As homes constitute about 90 per cent of the building damage in bushfires, it is worthwhile taking some action to preserve them. Among the actions which Ted Foster recommends in *Bushfire: History, prevention, control* (Reed, Sydney, 1976) are:

- Fill knapsacks, buckets, tubs and bath with water.
- Attach hoses to taps and assemble at a central point such fire-fighting tools as knapsacks, rakes, shovels and beaters.

- Close all windows and doors and wind up car windows.
- Clear roof gutters of leaves and debris and remove flammable material from under the house.
- Get dressed in woollen clothes and heavy boots if possible and don't wear synthetic materials.
- Stuff downpipes with rags and fill roof gutters with water.
- Put a ladder up to the manhole in the roof and a bucket of water near the manhole.
- Put another one up to the roof outside the house.
- Douse shrubs and grass and turn on the roof sprinkler if you have one.
- Immediately extinguish burning leaves or bits of bark that blow towards the house.
- Watch the roof for outbreaks of fire.
- Stay inside for the few minutes it takes for the flame front to pass, then check the roof, timber frame, garage and shed.

To summarise, the main causes of death in bushfires is failure of the body's heat regulation mechanism because of exposure to high levels of radiated heat. Exposure to smoke or hot gases in a bushfire may be fatal. It may also cause panic which leads to people exposing themselves to radiated heat. The best protection from radiated heat is an opaque material, such as clothing, blankets, rugs, bags etc.; wood, earth and even the metal body of a motor vehicle. A car or a house is a good protection. The high intensity flaming period of a bush-fire rarely exceeds 4 minutes in any one place. A car is the last means of survival available and the logical advice is not to drive on smoke-filled roads close to large bushfires or across the path of large bushfires. If you have to be near a bushfire with poor visibility due to smoke, drive with your headlights on.

The Forestry and Timber Bureau offers these basic rules for survival in a bushfire :

- If fire threatens your house—stay there. You will survive peak radiation from the fire even if the house burns down later and you stand a good chance of saving the house as well.

At Longwood, Victoria, in 1965, seven people left a threatened homestead surrounded by green lawns and crashed their car into a tree on the side of a narrow country road. They were burnt to death. Although the impact of the crash was slight the car was left on a very heavy fuel bed and possibly with broken windows. The homestead did not burn down until well after the fire had passed and would not have burnt down at all if only one person had stayed to fight the fire.

- When approaching a fire note possible refuges such as shallow dams, native pastures carrying light fuel, creeks, soaks and dugouts.
- Avoid panic by preparing to fight the fire around the house. Direct other people to useful jobs such as filling utensils with water, blocking cracks with wet blankets and ensuring windows and doors are tightly closed. Able-bodied people should be keeping watch for spot fires on the outside of the house until the very last minute. People kept occupied usually don't have time to panic.
- Do not drive a motor vehicle blindly through heavy smoke. Switch on headlights and park adjacent to bare areas beside the road—as far away as possible from the leading edge of the fire, or park where roadside grass is shortest.
- Wind up the windows and shelter from radiation beneath the dashboard with a rug or some other article (such as a floor mat) covering your body. If the vehicle catches alight you can leave it but keep your skin covered as much as possible.

- Remain calm and have confidence that the petrol tank will not explode and that even in the worst situations it will be some minutes before the vehicle catches alight.

In a grass fire the flames will last for 30 seconds or less and the chances of survival are very good. In a high intensity forest fire the flames will last for 3 to 4 minutes and your chances of survival are lower but they will be better in a vehicle than in the open.

Survival on foot in a forest fire or a grass fire is not at all easy—even for experienced persons. The following instructions are of the type given to fire-fighters who have some knowledge of the forest and forest fires, but do not guarantee survival in every forest fire situation :

- Try to move on to bare or burnt ground.
- Do not run uphill or away from the fire unless you know a safe refuge is handy.
- Move across the slope out of the path of the head fire and work your way downslope towards the back of the fire.
- Do not attempt to run through flames unless you can see clearly behind them. This generally means that the flames are less than 1.5 m high and less than 1.5 to 3 m deep at the back or on the flanks of the fire. Lulls in the fire often result in the flames in these parts being low enough to step or run through to the burnt ground beyond.
- When conditions become severe use every possible means to protect yourself from radiation. On bare ground cover yourself with dirt or sand if possible or use wheel ruts, depressions, large rocks or logs to give protection. If you stay put you have a fair chance of survival.
- Take refuge in ponds, running streams or culverts, but avoid elevated water tanks. Water at ground level does not heat up quickly but in elevated tanks it becomes warm very rapidly. A body immersed in lukewarm water cannot sweat and at a temperature of 44°C a state of collapse will be reached in about 3 minutes. In 1939

some persons died in Victoria during fires after climbing into elevated water tanks.

- Remain calm and do not run blindly from the fire. If you become exhausted you are much more prone to heat stroke and you may easily overlook a safe refuge. Consider an alternative course of action.

Behind all these instructions are three basic principles which must be remembered at all times:

- Select an area where there is the least amount of combustible material.
- Use every means to protect yourself from radiation from the flames.
- Remain calm and don't panic.

FLOODS

Floods occur almost every year in Australia. They can occur at any time and in any stream or river. They may be caused by tropical cyclones, moist low pressure systems, sudden heavy rainfall, cyclone surge, high tides, seismic sea waves, earthquakes and dam failures.

Coastal floods are normally caused by heavy rains on catchment areas. Streams rise swiftly. Flood plains, towns, bridges and roads are inundated. The warning time may be short, but so are the floods themselves. They normally last from a few hours to a week.

Inland floods are normally caused by heavy rain over inland rivers causing rapid rises in water levels. Inland streams generally rise more slowly than those on the coast but periods of inundation are longer, isolating properties, communities and traffic routes. Warnings are usually given well in advance of the flood.

Flash floods result from torrential rain and thunderstorms, normally in spring and summer. They may occur anywhere but usually affect the upper reaches of rivers and creeks and cities. They cause rapid overflow of creeks, drains and culverts and sudden inundation of homes, roads and bridges.

Floods are natural disasters and most communities subject to them have the aid and advice of official organisations. Here are some general rules from such authorities.

- Heed the official warnings, alerts and advice.
- Be wary of gossip and rumours.

Upon a flood warning

- Listen to radio and television for further warnings and instructions.
- Fill clean water containers.
- Move belongings above the estimated flood height.

On warning of local evacuation

- Switch off electricity and gas.
- Empty refrigerators and deep freezers.
- Take an emergency evacuation kit.
- Follow evacuation instructions.

During the flood

- Don't drink floodwater.
- Don't spread rumours.
- Don't use the telephone unless you need help or have to report an emergency.
- Don't hinder operations by sightseeing.

After the flood

- Don't use food and drink which has been in contact with floodwater.
- Boil all water until supplies have been declared safe.
- Don't handle wet electrical equipment.
- Beware of contracting infectious diseases from paddling in stagnant and/or contaminated water.
- Wear strong shoes when wading in floodwater in case you step on sharp sticks, broken glass etc.
- Beware of snakes and spiders which may seek dry conditions in your house.



In rural areas

- Paint the name of your property on your roof.
- If you have a radio transmitter, paint the call sign and frequencies on the roof.
- Clear a non-flooding area as near as possible to your house for a helicopter landing pad or a site for dropping supplies.
- Maintain levee banks and flood drains.

CYCLONES

Tropical cyclones are the most dangerous, most deadly storms on earth. Known elsewhere as hurricanes or typhoons, they can claim the lives of thousands; can cause damage costing million of dollars. The winds in a cyclone whirl clockwise around a calm 'eye'. To qualify as a cyclone the winds must reach or exceed 63 km/h, but at their most destructive the

gusts can exceed 200 km/h. In Australia the main target of cyclones is the tropical coastline, between November and April, but cyclones can strike at other times and in other areas.

A cyclone may be 300 km or more wide. Its winds can turn a sheet of galvanised iron into a guillotine, a coconut into a cannonball, a stone into a bullet. Torrential rain may add to the destruction and havoc. Gusts can be up to 60 per cent stronger than the average wind speed. Cyclones bring winds freshening to gale force and above, and rain squalls increasing in frequency, then hurricane force winds and flying debris.

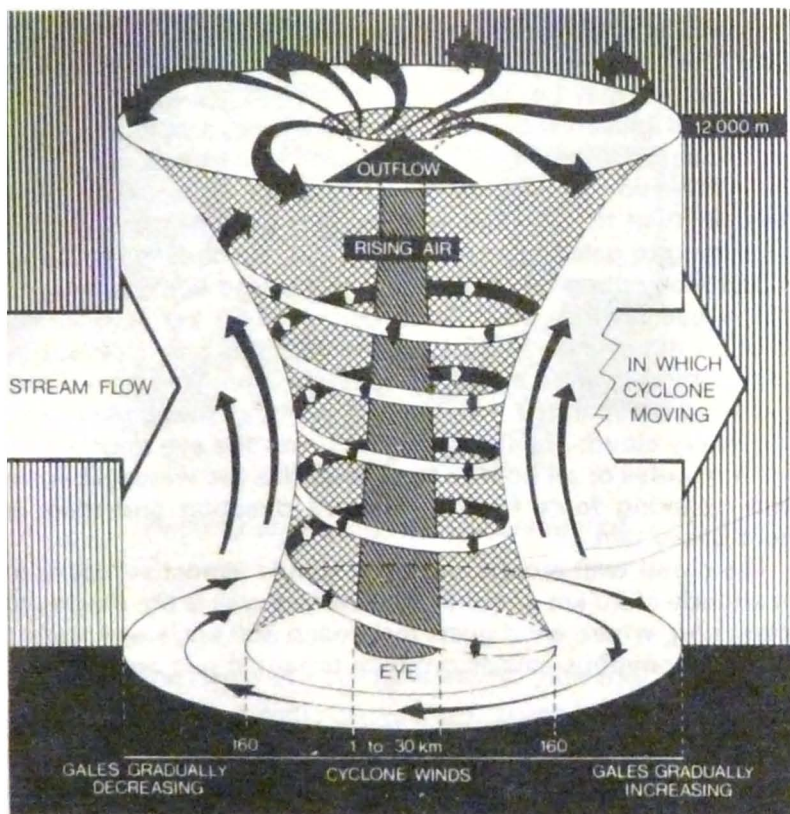
The eye itself is sometimes less than 10 km in diameter (though it may exceed 30 km across) and is characterised by a sharp drop in wind speed, no rain and often very little cloud. It is sharply separated from the surrounding strong wind, rain and heavy cloud. The lull associated with the eye may last for a few minutes or an hour or two. After this the winds hit again with battering force from a different direction and there is more heavy rain.

The cloud wall around the eye extends almost vertically to an altitude of 20 km or more. Outside this wall is the maximum speed ring, where wind gusts may reach 300 km/h and towering cumulonimbus clouds produce torrential rain and thunder activity.

The strong winds around a tropical cyclone generate high waves, which travel outward from the storm at an average speed of more than 1500 km a day. This may be several times greater than the speed of movement of the cyclone (which varies from 5 to 50 km/h) and so the arrival of a heavy swell is a useful warning of cyclonic activity.

Storm surge

A cyclone near a coastline will generate a storm surge—an extremely high sea level caused by the wind 'piling up' the water against the coastal shelf. Seas may rise 5 metres or more and if a storm surge occurs at or near high tide it may flood low-lying areas for kilometres inland. Storm surge is caused by a combination of low pressure and cyclone winds piling sea water up against a sloping coastal shelf to produce a



Structure of a tropical cyclone

storm tide (above predicted tide). The rising water floods inland over low-lying areas normally above tidal influence.

Given a critical combination of weather factors, an ordinary tropical depression or 'low' can develop into a tropical cyclone.

Summer sun beating on the warm ocean evaporates water creating a deep layer of moist air. The uplift of this moist air in the centre of a low cools it, causing the intense rain characteristic of tropical cyclones. High in the atmosphere, the rising air spirals outwards, removing air faster than it flows inwards at low levels. The result is a falling barometric

pressure. The latent heat released by the rain maintains the energy of the storm.

The clues to the birth of a tropical cyclone may be a suspicious cloud patch on a satellite photograph; strong winds and falling barometric pressure reported from ships, a coastal observing site or an automatic weather station off the coast; high-level wind indications from weather balloon flights or aircraft reports; persistent thunderstorm activity discovered by radio direction-finding equipment registering on lightning strikes; an increase in very small earth vibrations (known as microseisms) caused by the storm; or the more obvious increases in sea or swell conditions. Once a cyclone is detected and nears land, radar joins in and the existing network of official and part-time weather observers is boosted by alerting people in the Bureau of Meteorology's cyclone-reporting screen. All Bureau of Meteorology cyclone warnings come from the Tropical Cyclone Warning Centres at Brisbane, Darwin and Perth, where meteorologists keep a round-the-clock watch during the cyclone season (November to April), with December to March the danger months. The three centres are responsible respectively for the eastern, northern and western regions of tropical Australia, and their warnings are based on analysis of a great volume of weather information. This information may come from the network of land reporting stations; from the offshore automatic weather stations along the northern, eastern and north-western coasts; from weather satellite cloud photographs; from upper air observations gained by balloon-borne instruments; from weather-watching radar units; and from ship or aircraft reports.

If tropical cyclone development appears likely or a cyclone is detected within 800 km of the coast, the Bureau issues either a CYCLONE WATCH or a CYCLONE WARNING.

Cyclone watch

This means a cyclone is approaching but is not expected in your locality in the next 24 hours. But it may affect the locality after that time (often within 48 hours). This message is designed to alert communities to the existence of a potential

threat and give them time to take precautions in case a warning follows later. Listen frequently to radio and television for further advice.

Cyclone warning

This means a cyclone is expected to threaten your community within 24 hours. Be prepared. Remain tuned to your radio. Warnings will be issued every 3 hours, or hourly if the cyclone is tracked by radar.

The Bureau of Meteorology warnings include advice on cyclone storm tides when necessary. Usually they are given as 'abnormal' or 'dangerously high' tides.

In official Bureau of Meteorology warnings :

- *Gale* means winds reaching or exceeding 62 km/h.
- *Severe cyclone* means a cyclone with highest average wind strength around the 'eye' of at least 120 km/h.
- *Destructive winds* is reserved for average winds reaching or exceeding 90 km/h.
- *Very destructive winds* is used for average winds reaching or exceeding 120 km/h.
- *Gusts* can be of 60 per cent greater speed. Remember wind pressure increases as the square of its speed. Winds of 200 km/h may be four times as dangerous as 100 km/h winds.

Based on the predicted wind strengths and storm tide height, it may become necessary to evacuate some areas to avoid casualties. Be ready to move to higher ground. High winds and flooded roads will be hazards during movement. Advice will be given through local TV, radio and other media. Police and State Emergency Services personnel will also give verbal warnings.

Points to remember

Cyclones don't always give hours of warning. Don't trust your own weather observations. Follow Weather Bureau warnings.

Beware the 'eye'. You may feel reassured, but soon the

wind will be back in full force, from another direction. Stay protected. Do not go outdoors.

Random paths Cyclones can change course, mark time, even loop the loop. Keep listening to your radio after the cyclone has passed—it may double back.

Keep listening to your radio after the cyclone warning has been issued. Radio and television broadcasts of Bureau warnings are frequent and provide more up-to-date information than newspapers. A transistor radio, with spare batteries, is a lifeline to the outside world if floods or power failures isolate an area.

What to do

Before the cyclone season

- Be sure that your transistor radio is working and that you have fresh spare batteries.
- Check that your house is sound, particularly the roof.
- Clear your property of loose sheet iron and other potential missiles.
- Know your community disaster plan.
- In case of a storm tide warning, know your nearest safe high area.
- Collect tinned food, water containers, emergency lighting, candles, essential clothing, first aid kit, medicines.

Upon a cyclone warning

- Listen to your radio and TV for further warnings.
- Batten down your house, secure doors, board or tape windows, store loose articles inside.
- Lock up your pets, fill water containers, fuel your car and place it under cover.

On warning of a local evacuation

- Lock up your dwelling, switch off the electricity, gas etc.
- Take your emergency evacuation kit.

- Follow advice given.
- Heed warnings—they are not given lightly !

When the cyclone comes

- Keep calm, stay inside.
- Shelter in the strongest part of the house—perhaps the bathroom or internal toilet.
- If the house starts to break up, protect yourself with mattress and blankets. Anchor yourself to a strong fixture (such as water pipes) or get under a strong table or bed.
- Beware the calm ‘eye’. Remain indoors until advised that the cyclone has passed.

After the cyclone

- Don’t go outside until advised officially or you are positive the cyclone has passed.
- Listen to your radio.
- If you had to evacuate, don’t go home until advised. Use the route recommended.
- *Don’t* panic.
- *Don’t* stay in the open.
- *Don’t* go sightseeing.
- Above all, *Don’t ignore warnings!*

Emergency/evacuation kits

Emergency kit (hold ready in house)

1. Battery-operated radio. Tinned food. Water in containers. Torches. Candles. Matches. Essential clothing.
2. Emergency self-contained cooking gear.
3. First aid kit. Essential medicines.

Evacuation kit (carried in small bags)

Emergency kit plus

1. Warm utility clothing (jeans, skivvies etc.)

2. Wear thick clothing to protect yourself against flying debris. Strong sensible footwear (not thongs) should be worn.

Note : Managers of hotels, motels, caravan parks etc. should take steps to ensure visitors are familiar with the dangers and know what to do in the event of a cyclone warning.

Many of these lifesaving precautions can be taken immediately.

EARTHQUAKES

Introduction

Earthquakes are sudden, normally unpredictable, movements within the earth, usually associated with faulting, or phase changes, which can cause perceptible vibrations, violent shaking or even rupturing of the ground. They last from a few seconds to as much as several minutes, and could come in a series over a period of several days. Most casualties result from falling objects and debris caused by the shaking.

The risk

By comparison with a number of other countries, earthquake activity in Australia is low. However, there are some Australian regions where the risk is sufficiently high to call for an informed understanding of the problem by the community.

During the shaking

1. Do not panic. The motion of the earth is frightening, but you will increase your chance of survival if you remain calm.
2. If you are indoors when the earthquake starts, stay there. Take cover under a desk, table, bench, or in the doorways of halls or against inside walls. Stay away from glass and outside walls.
3. Do not use candles, matches or other open flames either during or immediately after a tremor. Douse all fires.
4. If you are caught out of doors, move away from buildings and utility wires. Once in the open, stay there until the shaking stops.

5. Do not run near or through buildings. The greatest danger from falling debris is just outside doorways and close to outer walls.
6. If you are in a moving car when the earthquake occurs, stop as quickly as safety permits, but stay in the car. It may bounce and jiggle on its springs in a frightening way, but it is a good place to stay until the shaking stops.

After the shaking

1. Check your utilities, but do not turn them on. Earth movements may have ruptured water, gas or electrical lines.
2. If you smell gas, open windows and shut off the main valve. Then leave the building and report gas leakage to the authorities. Do not re-enter the building until a utility official says it is safe.
3. If water pipes are damaged, shut off the supply at the main valve. If electrical wiring is shorting out, shut off the current at the main meter box.
4. If there has been severe structural damage to buildings in the area, do not go into any of them without permission from rescue or emergency authorities.
5. Accept instructions only from a recognised authority. Do not believe or repeat rumours.
6. Keep tuned to your radio for official instructions.
7. Use phones for emergencies only. Don't phone the police, fire brigade or civil defence authorities unless you need help or have to report an emergency.
8. Don't tackle too much. If you find you must leave a disaster area or are requested to do so, leave quickly. Don't attempt to save belongings if you or your family are exposed to danger. Don't undertake search and rescue operations on your own. Volunteer your services to the proper authorities. They have trained leadership.
9. Stay clear of disaster areas. Sightseers are a hindrance to rescue workers and may become casualties themselves.

The average Australian who finds himself in danger at sea will probably be in a small craft. Inexperience is the principal cause of loss of life in small boats, says the Commonwealth Department of Transport, which has produced two useful booklets, *Safety for small craft* (Australian Government Publishing Service, Canberra, 1970) and *Distress procedures for small craft* (Australian Government Publishing Service, Canberra, 1975). It is not possible to reproduce here all the information contained in these two booklets. Anyone going to sea in a small boat would be well advised to read them.

Boats

The best way to avoid a survival situation in a small boat is to plan to avoid it. Choose a boat which you can manage and which suits your level of seamanship. Keep it in good condition and sail it only in waters suitable for it. If you are an inexperienced sailor, don't take your boat outside sheltered waters until you have gained considerable experience of handling your craft and of local boating conditions. Don't indulge in deep-sea boating until you know your craft from stem to stern and have a thorough knowledge of engines, sails, and the equipment and procedures for lifesaving and fire fighting. Even then you should choose your weather, and preferably take an experienced sailor with you. And if you are going on a voyage of more than a day or two fill in a Movement Report Form obtainable from the Department of Transport or police and post it to the address indicated on the form.

Safety equipment

Some States and some yacht and power boat organisations prescribe the safety equipment which must be carried in small craft. The Department of Transport makes detailed recommendations in its booklets.

The seaworthiness of the yacht is the prime factor to be considered. Yacht owners should anticipate spending long periods at sea where there may be no harbour or refuge within easy reach and no means of obtaining assistance.

It is recommended that power boats, when their size permits, carry equipment similar to that recommended for sailing vessels making similar voyages.

The most important item of safety equipment on a small craft is the lifejacket. Good lifejackets should be able to keep an unconscious wearer afloat in an inclined position with head and face clear of the water. The best lifejackets are those which comply with the 1960 Safety of Life at Sea Convention.

Lifejackets should be worn at sea at all times by children and non-swimmers and by everyone during periods of rough weather. The lone sailor should also clip a lifeline to the rail or an eyebolt and fasten it around his waist.

Lifebuoys have two main uses. They provide buoyancy for a person swept overboard and make his or her position more easily identifiable. They are made of cork, or unicellular foam and fibreglass, may be covered with canvas or fibreglass, and are coloured orange.

Every craft except perhaps the smallest dinghy should have a pump and the larger the boat the larger the pump should be. They should be simple in construction, self-priming, easily cleaned, well secured, easily accessible and in working order.

Most small craft should carry a first aid kit.

Fire extinguishers

The Commonwealth Department of Transport says that any enclosed engine space should be provided with a fixed fire-smothering arrangement consisting of a cylinder or cylinders of CO₂ gas or BCF (bromochlorodifluoromethane) permanently piped to the space and fitted with an external pull mechanism

by means of which the gas can be released into the space to extinguish a fire. Only a small amount of gas is needed.

Portable extinguishers

No single extinguisher will deal equally effectively with every type of fire. Four types of fire extinguishers are commonly used afloat—water, foam, CO₂ gas and dry powder. From these four types you should select not more than two for your boat.

Avoid water extinguishers fitted with a 'marine cap'. Only water extinguishers that contain a sealed inner cylinder of CO₂ gas which cannot be released until a knob is struck to pierce the seal of the inner cylinder should be used.

Foam extinguishers are of two types: chemical foam and air foam. The foam produced is effective against fires involving oils, fats, greases, petrol, and other inflammable liquids. The foam is persistent and has the effect of blanketing and preventing reignition from hot materials or surfaces and therefore provides time for cooling down. They should *not* be used against electrical fires.

Carbon dioxide (CO₂) extinguishers are suitable for use against all types of fires, including electrical, but are most effective when the space in which the fire occurs is confined. Its cooling effect is small and if reignition is likely to occur its use may have to be followed up by another extinguishing agent or a second extinguishing. As its effect is to reduce the oxygen available to sustain the fire it is not effective in the open air where the gas blanket is readily dispersed. It does not possess the cooling or penetrative effect of water when used against carbonaceous substances.

Bromochlorodifluoromethane (BCF) type extinguishers are suitable for use against all types of fires and, although most effective against electrical fires and fires involving fuels, oils and greases, they will deal quite effectively with small carbonaceous fires (wood, upholstery materials etc.)

Dry powder extinguishers, also known as 'dry chemical', are suitable for any type of fire including electrical and the coating of powder remaining on the apparatus may be readily cleared. They are fast acting and particularly efficient against

fires involving fuels, oils and greases but are not very effective in preventing reignition from hot surfaces or in penetrating and cooling carbonaceous materials, so follow-up action may be required.

Never use extinguishers that emit or generate toxic fumes in enclosed spaces, and the following guide is provided concerning the toxicity of available extinguishers:

Water jet types	Harmless
Air foam	Non-toxic
Chemical foam	Non-toxic
Dry powder	Non-toxic
CO ₂ (carbon dioxide)	Non-toxic but if the concentration is excessive can cause suffocation. The quantity in portable extinguishers is usually insufficient to introduce any significant risk.
Chlorobromomethane	Toxic
Carbon tetrachloride	Toxic
Methyl bromide	Highly toxic
BCF (bromochlorodifluoromethane)	May cause some irritation to nose and eyes in confined spaces—no lasting effect.

Care of fire extinguishers

The boat owner should make frequent inspections to be sure his extinguishers are in their proper stowage brackets and undamaged. Cracked or broken hose should be replaced, and nozzles should be kept free of obstructions. Extinguishers having pressure gauges should show pressure within the designated limits. Locking pins and sealing wires should be checked to ensure that the extinguisher has not been used since last recharged. Extinguishers should never be tried merely to see if they are in proper operating condition because in many cases the valves will not properly reseal, thereby resulting in a gradual discharge. A discharged extinguisher should be recharged at the first opportunity.

Radio communications

Small craft operators with radios should read the Department of Transport booklets for details of frequencies available and their usefulness, and for radio distress procedures.

Distress signals

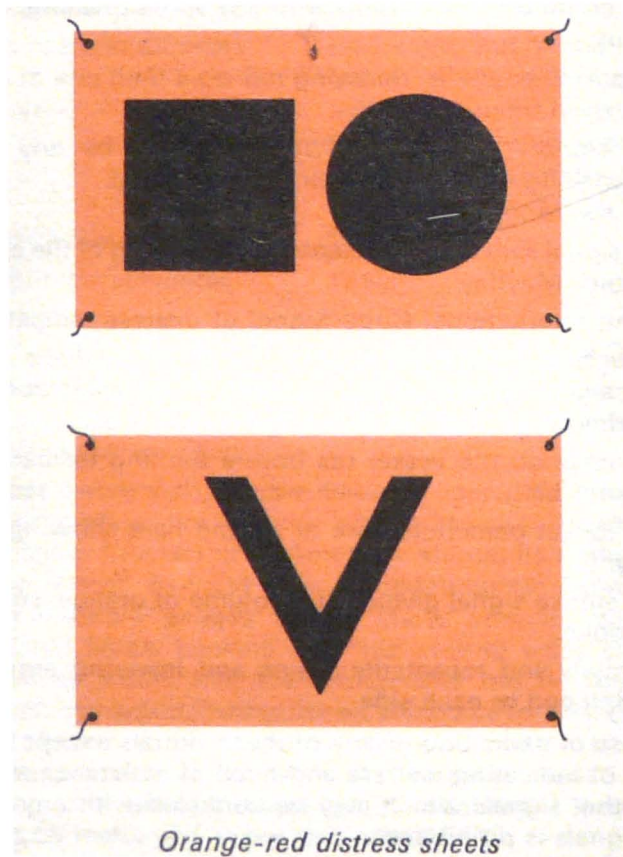
If your vessel is in distress and you require assistance from other vessels or from the shore, use these internationally recognised distress signals, either separately or together :

1. A gun or other explosive signal fired at intervals of about a minute.
2. A continuous sounding with any fog-signalling apparatus.
3. Rockets or shells, throwing red stars fired one at a time at short intervals.
4. A signal made by radiotelephony or by any other signalling method consisting of the group . . . - - - . . . in the Morse code.
5. A signal sent by radiotelephony consisting of the spoken word 'Mayday'.
6. The International Code Signal of distress indicated by NC sent by flags, (- . - . .) lights or sound.
7. A signal consisting of a square flag having above or below it a ball or anything resembling a ball.
8. Flames on the vessel (as from a burning tar barrel, oil barrel etc.).
9. A rocket parachute flare or a hand flare showing a red light.
10. A smoke signal giving off a volume of orange-coloured smoke.
11. Slowly and repeatedly raising and lowering arms outstretched to each side.

The use or exhibition of any of these signals except for the purpose of indicating distress and need of assistance and the use of other signals which may be confused with any of the above signals is prohibited.

To help search aircraft identify small vessels in distress a signal consisting of a highly visible fluorescent sheet which will make a vessel more readily visible from the air has been brought into use in the Australian Search and Rescue Area.

The signal consists of a rectangular sheet of material international orange in colour bearing either the black square and ball or the letter V in black. The sheet should measure not less than 2 metres by 1.3 metres and the symbols not less than 0.7 metres in height. Larger sheets may be used with advantage,



but sheets smaller than 1.8 by 1.2 metres are of little practical help to searching aircraft. The sheet may be made of canvas or other materials, robust enough to withstand the buffeting it may receive in strong winds. It can be made either by painting material with a fluorescent orange-red paint or by using a self-coloured international orange-red material. It should be fitted with an eyelet and lanyard at each corner.

The sheet may be exhibited in any manner which will best attract the attention of any aircraft or surface craft in the vicinity or of persons ashore. In open boats the signal sheets should at all times be attached to the boat by a lanyard so that if the boat capsizes it would be possible to locate the sheet and spread it over the top of the overturned boat.

The exhibition of the signal sheet in any manner by a vessel in the Australian Search and Rescue Area will be taken to mean 'I am in distress and require assistance'. It is not an international signal, so that overseas ships may not know its significance, but its use will nevertheless help to attract attention. The person in charge should ensure that the signal is only exhibited when the craft is in distress and requires assistance.

There are internationally recognised signals which are used by aircraft engaged on search and rescue operations to direct vessels towards a ship or person in distress. These are illustrated in Appendix III.

Lifesaving signals

There are internationally recognised landing signals to be given by persons ashore for the guidance of small boats with crews or persons in distress. There are also signals which may be made by persons ashore to indicate to persons in distress that they have been seen and assistance will be given as soon as possible. These signals and the answering signals made by lifesaving stations or maritime rescue units are illustrated in Appendix III.

The sea— abandoning ship

11

There are no universally applicable rules about abandoning ship because conditions which cause abandonment may vary greatly. This chapter sets out some general principles which could be useful in many situations.

If you are in a ship the captain will make the decision to abandon ship, but if you are in your own small craft you will have to make it yourself. Remember that an accident on board doesn't necessarily mean you will sink. You will probably be safer on board a disabled craft than you will be in the sea. If you avoid immersion, you will have a much better chance of surviving than if you get wet. If fire, explosion, swamping or capsizing causes you to abandon your craft, try not to leave the area. Searchers will have a better chance of finding you if they find your boat. As many small craft have built-in buoyancy tanks, they may remain afloat for a long period even when damaged or partly swamped. If so, they will help keep you afloat. A good general rule is that unless the boat is afire, stay with it. If you have the time, give the proper distress signals before you leave it. If possible, don't leave it until the vessel stops, and then try to leave on a lifeboat or raft. Before you leave, don a lifejacket. A good one will keep you afloat without any physical effort from you. It will keep your mouth and nostrils clear of the water and will hold you in a position midway between the vertical and face-up horizontal position. It will also keep you in the preferred survival position: facing oncoming waves. Avail yourself of any time you might have to gather clothing, blankets, water and food and have a good drink before you go. Try to enter the lifeboat or liferaft dry. A dunking in cold water will decrease your chance of survival.

The same general guides apply to abandoning a ship. If you can climb down a ladder, rope or hose and board a lifeboat or liferaft dry, do so. If you have gloves handy, wear them and go down hand over hand. You will get rope-burn if you slide down and this can be painful in salt water, particularly if the water is contaminated by oil. It may also cause blisters and infections.

If you can't climb down, jump—don't dive. Don your lifejacket. Throw in a lifebuoy if you have one (don't try to wear it when you jump as it might knock you out). Then hold one arm across your lifejacket to press it close to your chest and hold your nose with your hand. Jump with your legs extended and slightly bent and your feet together. Board a raft if there is one near. If not, swim at least 100 metres clear of the ship.

If the ship is drifting, jump over the weather, or windward, side, so that the ship isn't driven upon you. When the ship is listing, or the sea is running high, jump from the bow or stern, preferably the one lower in the water.

If you jump from the high side of the ship, you may strike the bilge, keel or propellers or injure yourself on barnacles on the exposed part of her bottom. If you jump from the low side, you may be struck by the superstructure should the ship capsize before you can swim clear.

If you are wearing a pneumatic rubber lifejacket and can swim, or if you are making a high jump, jump before you inflate it, then swim 100 metres from the vessel. If you are wearing a kapok lifejacket, draw tight and tie all ties and drawstrings before you jump. If you have an inflatable lifejacket, discharge only one of the attached CO₂ cartridges. This will inflate your jacket enough to keep you afloat. Use the other when needed. Remember to swim on your back when wearing a lifejacket and, if you have to float for a long time, do so with the back of your head to the sea and wind.

It may be difficult to keep liferafts clear of the ship's side in strong winds. They will be blown against the ship on the windward side and the ship will tend to drift on to them on the leeward side. To free them push them along the side to either bow or stern.

If you have to jump when the ship is surrounded by burning oil, take off your boots and heavy clothing; remove your life-jacket if it is an inflatable one; hold it in your hand; take a deep breath; cover your nose, mouth and eyes; jump in feet first, and swim underwater for as long as possible. Spring high as you surface, sweeping your arms wide about you to disperse the flames. If possible, face downwind before inhaling, trying not to inhale smoke, then continue to swim underwater.

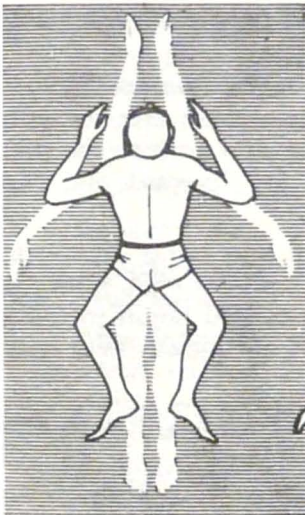
If there is oil on the surface but it isn't burning, hold your head high, try to keep the oil clear of your eyes, nose and mouth and be sure not to swallow it. Use your hand-held lifejacket as a raft. Don't worry if fuel oil gets in your eyes. It will inflame them for several days but generally will do no permanent damage. Wounds affected by oil heal normally.

When clear of the ship cling to any floating wreckage available. A packing case board will support even a large person. If you invert an empty bucket or drum so as to trap air inside it and hold it as low under the surface as possible, it too will support you. Fuel drums, tanks and containers will float, even when full, so throw them in the water and use them for buoyancy. Don't attempt an impossible swim to shore. Don't waste energy by trying to keep up with the abandoned ship if it is drifting away. Float on your back and exert yourself as little as possible. If there are other swimmers, stick together. Rope yourselves together by the toggles and lines on your lifejackets, preferably in a circle facing outwards.

Survival swimming

If you are a good swimmer and believe you can swim to shore, the breast-stroke is recommended as the one which will conserve energy and yet allow you to maintain a reasonable speed. The dog-paddle is slower but also conserves energy and is a good stroke to use when wearing a lifejacket. The sidestroke and the backstroke are good relief strokes, but the crawl is not recommended as it is tiring, particularly if you are clothed and wearing a lifejacket. For simply staying afloat, back-floating—lying face up with head partially submerged—is a

breast-stroke



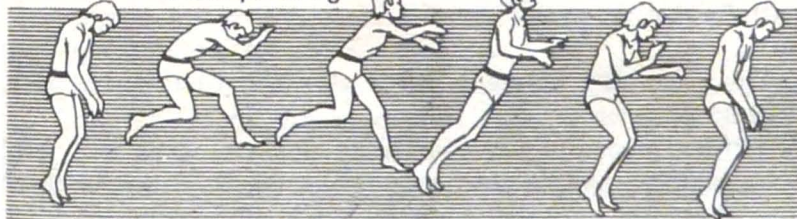
dog-paddle



sidestroke



drown-proofing



travel stroke



useful technique. But the most commonly recommended survival swimming technique is called drown-proofing. There are two versions of it, one for 'good floaters', one for 'poor floaters'. Drown-proofing is based on conserving the energy needed to keep your head out of the water. The aim is to keep as little of your head out of the water for as short a time as possible. Good floaters should follow these six steps :

1. Breathe through your mouth. Sink. Drop your chin on your chest. Float relaxed, vertically, with your arms and legs dangling.
2. The air you have inhaled will make you float to the surface. When your head is partly out of the water and you need to breathe again, slowly raise your arms to the side and simultaneously stretch one leg forward and the other back in a scissors kick.
3. Gently pull your arms downward and bring your legs together to raise your mouth, but not your chin, from the water. Exhale through your nose as you begin to bring your arms down. Inhale through your mouth as it rises above the surface. ♦
4. As you sink again push gently downward with arms and legs to prevent yourself sinking too deeply.
5. Drop your head on your chest. Allow your body to go limp. Stay under until you need to breathe.
6. Repeat the cycle.

There are also six steps in the stay-afloat stroke for poor floaters:

1. Take a breath. Let your body go limp, arms and legs dangling and head resting horizontally with the back of the head protruding slightly from the water. If your buttocks swing upward, you have taken too deep a breath so exhale a little air through the nose.
2. The air you have inhaled will make you float to the surface. As you do so, slowly cross your forearms in front of your forehead and move your legs slowly into a running position, bringing one knee up towards your chest with the foot extended forward, and raising the rear foot as high as possible. Don't lift your head yet and don't move your arms or legs quickly or you will push your head under.
3. With legs extended and arms crossed, raise your mouth, but not your chin, out of the water. As you are coming up

exhale through the nose. When your mouth is out of the water inhale through the mouth.

4. As your head becomes vertical, sweep your palms outward so that they almost break the surface. Step gently downward with both feet and bring your legs together as you inhale.
5. Sink and relax.
6. Repeat cycle.

If you can't swim but have to get to a liferaft, use this six-step travel stroke :

1. After following the first five steps of one of the stay-afloat strokes your head is submerged. Push down gently with your hands (fingers together) so that you won't sink too deep.
2. Tip your head forward to a face-down position. Lift your hands to your forehead and move your legs into the running position described in step 2 of the stay-afloat stroke for poor floaters. This will raise your body to a more horizontal position.
3. Extend your arms forward, hands together, towards the surface. Make a frog-kick (it kicks with its hind legs) when they are fully extended.
4. As your feet come together in the frog-kick, slowly sweep your arms forward, outward, and then back in a breast-stroke, finishing the stroke with your hands at your sides. This will push you through the water.
5. Glide forward and upward towards the surface. Keep your body relaxed and your hands at your thighs as you do so. Exhale a little air through your nose as you glide. Return to a vertical position by bowing your back, bringing both knees towards your chest and raising your hands towards your forehead.
6. As your body returns to the vertical position extend one leg in front of you and bring the other knee up to it. Now cross your arms in front of your head, forearms together, palms out. Raise your head for a breath.

When performing any of these strokes remember to (a) clear the nostrils of all water when exhaling by blowing hard through the nose and (b) keep all your movements slow and gentle to conserve energy.

Drown-proofing is an effective way of helping non-swimmers to survive in reasonably warm water, or when they have no lifejackets, but it doesn't work in water with extremely cold temperatures. A team of researchers at British Columbia's University of Victoria found that in water as cold as 10°C the average person swimming in a lifejacket cooled 35 per cent faster than when still and would only cover 1.3 km before being overcome by hypothermia (loss of body heat). They also found that the fastest way to die from hypothermia at this temperature was by practising drown-proofing. A person doing this cooled 82 per cent faster than when still, mainly because his head, a high heat loss area, was in the water. Treading water was as fatal as trying to swim, the cooling rate being 34 per cent faster than when staying still. The warmer the water the longer the life expectancy. The researchers found that an average male wearing a regulation lifejacket and holding still would survive for about two hours in water at 5°C, three hours at 10°C, five hours at 15°C, and twelve hours at 20°C. They devised two methods to extend survival time. One is HELP (Heat Escape Lessening Posture), which may increase survival time by 50 per cent: hold your arms tight against the sides of your chest, which is a major heat loss area, and raise the thighs to protect the groin, another major heat loss area. The other is recommended for a group of survivors. They should adopt the 'huddle' position: cling to one another and press the sides of your chests together to increase survival time by up to 50 per cent.

The critical temperature of water for human survival is 20°C. Below this temperature heat production cannot keep pace with heat loss and thus keep the body at its normal temperature of 37°C. Sea temperatures differ widely. The hottest sea is the Red Sea, which exceeds 30°C, and the coldest seas are in Antarctica (below freezing). Elsewhere temperature depends on latitude and season. The Commonwealth Department of

Transport has published a table of the expected time of survival of a man immersed in the sea and also one showing the effect of wind on exposed persons. The Department points out that some people have far exceeded the expected survival times in the sea and that increased wind velocities greatly increase the danger of freezing of exposed flesh.

Guide to survival time for persons in water of various temperatures

<i>Temperature</i>	<i>Expected time of survival of man immersed in the sea</i>
Less than 2°C	Less than $\frac{3}{4}$ hour
2°C to 4°C	Less than 1 $\frac{1}{2}$ hours
4°C to 10°C	Less than 3 hours
10°C to 15°C	Less than 6 hours
15°C to 20°C	Less than 12 hours
Over 20°C	Indefinite (depends on fatigue)

Effect of wind on exposed persons

<i>Estimated wind speed (knots)</i>	<i>Actual thermometer temperature reading</i>					
	<i>10°C</i>	<i>0°C</i>	<i>-12°C</i>	<i>-23°C</i>	<i>-35°C</i>	<i>-45°C</i>
0						
10						
20						
30	Little danger for properly dressed persons		Increased danger of freezing of exposed flesh		Great danger of freezing of exposed flesh	
40 or more						

Raftsmanship

Good liferafts are buoyant, insulated, and have a distinctive colour so that they are easily sighted at sea; they are easy to board, provide for the collection and stowage of water, and are equipped with survival and first aid packs. Not all rafts meet these requirements and few, apart from those used by the Navy, are likely to have survival packs.

When you abandon ship and swim to a liferaft hang on to the handline encircling the gunwale and get your breath before trying to board it. If the raft has a scrambling net and ladder, use them, together with the lifeline next to the ladder, to board the raft.

Cut the lazy painter to the ship if the ship seems about to sink.

Then look for other survivors. Listen for cries and whistles and look for the lights of other rafts. In darkness switch on your raft marker light if you have one. By using the drogue or paddles you can guide the raft to survivors or arrest the drift of the raft while they board it.

To haul an injured person aboard, ensure that he or she has his back to the raft, grasp the survivor under the armpits, clasp your hands across the chest, push downwards until your arms are straight, then as you brace your knees against the buoyancy tube, pull the person aboard.

Once the raft has been filled to capacity take on no more survivors. One or two people too many could endanger the lives of twenty.

Place any compasses, matches, lighters, maps or watches in waterproof containers.

Salvage as many floating items as you may find useful. Dougal Robertson, who with his family survived 37 days in an inflatable rubber raft in the Pacific Ocean, found that 'surprisingly important' uses could be found for apparently useless pieces of debris, but he cautioned against taking on board anything likely to pierce the raft or wear a hole in its fabric. Rope, clothing and plastic containers will be useful. Stow them, and then check the raft for proper inflation, leaks and possible points of chafing. Water leaks are most likely to

occur at valves, seams and underwater surfaces and may be repaired with plugs supplied in liferaft kits. Top off inflation by pump or mouth so that buoyancy chambers are tight but not drum tight.

In rough weather keep the sea anchor out from the bow and sit low in the raft with passengers' weight distributed so as to hold the weather side down. Don't sit on the sides or stand up and don't make sudden movements without warning the others.

Having collected survivors, salvaged floating debris, and checked the raft, administer first aid to the injured and sea-sickness tablets to all. Water is the key to survival and you can lose a lot of water by vomiting. You can also waste it by drinking too early. You can do without water for the first day unless you are already dehydrated or you have lost blood, so don't drink for the first 24 hours. After that you should try to replace the water you lose. Your requirements will differ according to the climate you are in and the work you do. Remember that if you have little water to drink, you will have little to pass. Because of this, your urine will be a darker colour and you may experience a burning sensation when you pass it. Whatever you do, don't drink it! And don't drink sea water either! Don't even mix it with fresh water to eke out your rations.

Bail out your raft, and cover the floor with canvas or cloth for insulation. Then if there are other rafts near you, secure them to each other, preferably with about 7.5 metres of line. Connect the rafts only at the lifeline around the outer periphery of the raft. Shorten the line if you see an aeroplane, as a flotilla is more easily seen than a single raft or several rafts scattered over the sea. One rule is worth repeating: don't try to sail away from the area where your ship sank.

Resist the temptation to take off all your wet clothing unless the weather is warm and dry, as your clothes will protect you from sunburn and windburn. In the cold remove them layer by layer, wring them out and dry them. Wash off any oil on your body. Try to keep your head and face covered at all times and keep as dry and as warm as possible. Erect a canopy if your

raft has one. In cold climates huddle together for warmth and keep your feet and hands warm by moving them and by stretching your limbs. It is important to maintain blood circulation to avoid chilblains, frostbite and cramp.

Even in the tropics you still need clothing to protect you from sunburn, although you won't need extra warmth. Exposure to the sun increases thirst and wastes the body's water. Roll down your sleeves, pull up your socks, button your collar, improvise a hat, and keep the back of your neck covered. Try to catch as many breezes as possible and avoid any unnecessary exercise so as to prevent water loss by sweating. Don't go swimming. It wastes energy, increases your thirst, and may attract sharks. You can keep cool by keeping your clothing wet during the day, but make sure that it is dry by sundown. Tropical nights may be very cool.

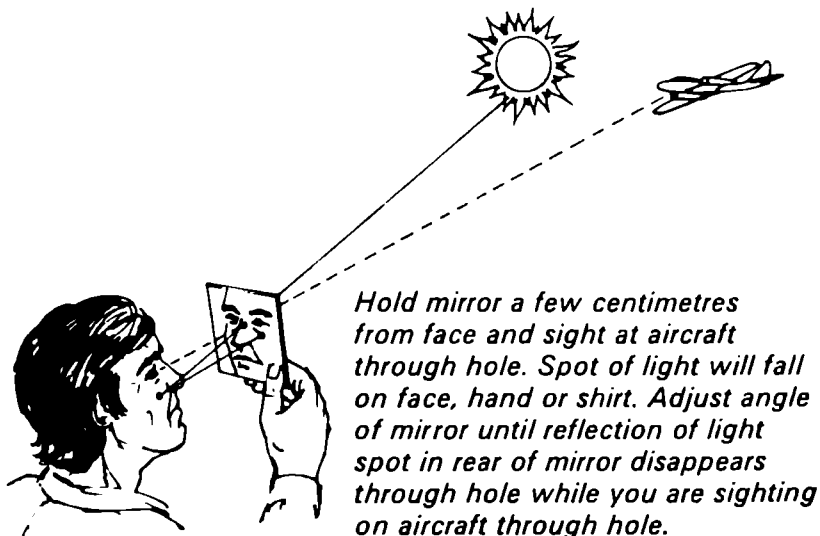
Life on a tossing raft is no picnic. Most survivors who have experienced it describe it as a nightmare. Seasickness, cramp, boils, calluses, sores and constipation are common. It is often difficult to sleep for a long period and in rough seas it is difficult, if not impossible, to urinate and defecate over the sides. Food and fresh water are easily contaminated by the sea and sea water will rot your skin, clothes and equipment. An American survival report says, 'To have no boat or raft can be disastrous (for a castaway), but to have to sit in one is almost as much of a physical and mental torture.'

Signalling

You are in a small raft on a very large ocean, so get your signals into operation. See Appendix III for illustrations of recognised signals.

If you have a transmitter, transmit your radio distress signals at frequent intervals or otherwise follow briefing instructions. Send signals as indicated in the instructions packaged with the transmitter. Exercise discretion in using battery-operated transceivers, since the batteries have a limited life.

If you have a corner reflector or other radar signalling device, set it up and leave it up except during storms. Handle it carefully.



Hold mirror a few centimetres from face and sight at aircraft through hole. Spot of light will fall on face, hand or shirt. Adjust angle of mirror until reflection of light spot in rear of mirror disappears through hole while you are sighting on aircraft through hole.

Practise signalling with a mirror if you have one. If you have no signal mirror, use an ordinary pocket mirror or any bright piece of metal. Punch a hole in the centre of the metal piece for sighting. On hazy days, aircraft can see the flash of the mirror before survivors can see aircraft, so flash the mirror in the direction of an aircraft when you hear it, even when you cannot see it. When the aircraft is sighted, keep signalling, but stop flashing if the aircraft is attempting a landing. Some raft paddles and oars are coated with material which will reflect the beam of a searchlight at night.

Use smoke signals in the daytime, and fire signals at night. Keep signal flares dry; don't waste them. *Be very careful of fire hazard when using flares.* Keep the flares dry at all times.

At night, use flashlights, recognition light, or blinker signal light of the radio. Any light can be seen from the air over water for several kilometres. At night or in fog, use the whistle from the emergency kit to attract surface vessels or people on shore, or to locate another raft if it becomes separated.

Water

If water is short, conserve what you have by keeping as cool as possible and doing as little as possible. If you have no

water, don't eat. You can survive for a long time without food, but not for long without water. Take seasick tablets to prevent water loss by vomiting. Use cloths, canvas and containers to catch any rain that may fall and try to keep your catchment vessels free of sea water and salt. While it is raining drink as much as you can hold. Mop up any dew that forms on the raft at night. Hang up spare clothes and squeeze out the dew. In ice regions get your water from old sea ice which is distinguished from young sea ice by its bluish colour, smooth corners and glossy surface.

Let's repeat this rule: Never drink sea water. Don't even mix it with fresh water when your supply is short. To extract the salt from sea water, your kidneys must use water which could be better used for other purposes by your body's tissues. If the fresh water in the tissues isn't continually replenished, your body begins to dehydrate. The more salt water you drink, the faster the dehydration. For the same reason, don't drink urine.

If you have a desalination kit or solar still, use it.

Food

Fish is the obvious food to seek at sea. If your raft has a fishing kit, use it. If not, improvise hooks from pins, clips, or shoenails. Make lines from shoelaces or strips of clothing. Try to catch the small fish that gather in the shadow of your raft and use them for bait. If you have a net or can improvise one, use it to scoop up fish, crabs and shrimp. Flying fish may land in your raft at night. Club them. Use a flashlight or mirror played on the sea to attract fish to your raft at night. Don't make your lines fast to your raft or to yourself in case they attract large, voracious fish. Most fish are edible, but some are dangerous to handle and others poisonous to eat. Don't handle fish until they are dead. Don't handle jellyfish at all. Don't eat those fish which have spines or bristles instead of scales. Avoid those which inflate themselves, have an unpleasant odour, or have slimy gills, sunken eyes, flabby skin or flesh which stays dented when pressed. Don't eat fish eggs or liver. Use the guts for bait. Don't eat shark's liver. Don't eat

the flesh of the hammerhead shark, the white shark, the six- or seven-gilled shark, or the black-tipped sand shark.

Fish which you do eat should be cleaned, cut and eaten immediately. The remainder may be cut into thin fillets, soaked in several changes of water, and dried in the sun.

Seals and whales are edible and so are the small squid and octopus which sometimes come aboard rafts. Most crab meat is edible and so are the liver and fat of sea turtles. Seaweed is also edible but it should be eaten only when you have plenty of fresh water to drink. You can eat the barnacles which may grow on the side of your raft or boat or on a line or net you trail behind you and any bird you are able to catch will also be edible.

Sharks

It is difficult to generalise about the behaviour of sharks, so the instructions in this section should be regarded only as general guidelines.

Statistically the chance of a shark attack is low. If one does occur it is more likely to be in a warm ocean rather than a cold one, because there are likely to be more sharks and more people there.

Sharks are inquisitive, but although they investigate many large floating objects, they normally swim away. Sometimes they will nudge the object. Sometimes they will follow a boat or raft for several days. Sometimes they will circle it several times.

Sharks are attracted—sometimes from great distances—by sounds and scents. A struggling man will attract them. And so will the scent of blood, urine, vomit, offal, foul matter and many types of fish bait.

The United States Air Force offers the following instructions to its members for dealing with sharks. When not in the raft, keep a sharp look-out for them. Use shark repellent, if you have some. Keep your clothes and shoes on. If your group is threatened, bunch together, form a tight circle, and face outwards. Ward off an attack by kicking or stiff-arming the shark.

If you are apparently undetected, stay as quiet as you can. Float. If you have to swim, use strong, regular strokes; don't make frantic, irregular movements. When swimming alone, stay away from schools of fish.

If a single large shark threatens at close range :

- Use strong regular swimming movements.
- Feint at the shark to see if you can scare it.
- If it attacks, face it and swim quickly to one side to avoid it.
- Make loud sounds by slapping the surface or shouting underwater.
- As a last resort, kick or stiff-arm it. Remember that sharks have a rasp-like skin which will cause brush wounds.
- Use a knife at close quarters in a showdown. Stab the shark in its gills or eyes. Remember a wounded shark may attract others.

If a shark threatens to attack the raft, jab at its snout or gills with an oar or fire a pistol above it.

Look for sharks around or under your raft before you go in the water. Don't dangle your arms or legs over the side. Don't urinate or defecate if a shark is near. Don't swim at night or when the water is dirty. Don't clean fish in the water when sharks are near. Don't fish from the raft when sharks are near and abandon a hooked fish if a shark approaches. Discard blood, vomit and body waste in small amounts and throw them as far from the raft as possible.

If a person is bitten, try to control the haemorrhage and shock.

If a member of your party dies, throw the body overboard, preferably at night, and move as far away from it as possible.

Travel

Winds and currents will make your raft drift. You can modify its course by using oars, improvised sails and the sea anchor but you will not be able to fully control it. You can't sail a raft into the wind as it has no keel. You can't sail it against a current. You can sail it downwind, however, and you can increase its pace by inflating it fully, sitting high, taking in the sea anchor,

and improvising sails. You can slow its movement by using the sea anchor and crouching low in the raft, and by using the paddles (if you must). But you are best advised not to sail or to paddle your raft unless you know land is near. Save your energy. Use currents and wind—don't fight them.

Landfalls

Signs that land is near include a fixed cumulus cloud in a clear sky or in a sky where the other clouds are moving; a greenish tint in a tropical sky; light-coloured reflections on clouds in Arctic or Antarctic waters; light green or light blue water, indicating shallows; the odour of swamps, the smell of smoke, and the roar of the surf; and a concentration of birds in one area.

If you have to swim ashore, wear your shoes and at least one thickness of clothing. If the surf is moderate, ride a wave in. If it is high, swim in the troughs, diving face first under the waves. If you have to land on a rocky shore, avoid places where the waves explode with a high white spray and seek a place where they rush up on to the rocks. Approach slowly and try to get a firm grip on the rocks. Advance behind a large wave into the breakers. Face the shore and take a sitting position with your feet in front, about a metre lower than your head, to absorb shocks. Water is calmer in the lee of a heavy growth of seaweed so take advantage of the growth. Don't swim through seaweed; crawl over it, grasping it with over-hand movements.

If you raft ashore, try to avoid doing so in a strong surf or into a low sun. Try to land on the lee side of an island. Look for gaps in the surf line and the mouths of freshwater streams. Avoid coral reefs, rocky cliffs and rip currents.

If you have to make a landfall through surf, take down your mast and sails. Keep your clothes and shoes on to minimise cuts and bruises. Inflate your lifejacket. Trail your sea anchor over the stern on its longest line. Choose a large wave and use your paddles to help you ride in. Don't jump out until the raft has grounded. Beach the raft above the high-water mark and make it fast to a rock, tree or bush so that it doesn't blow back into the water.

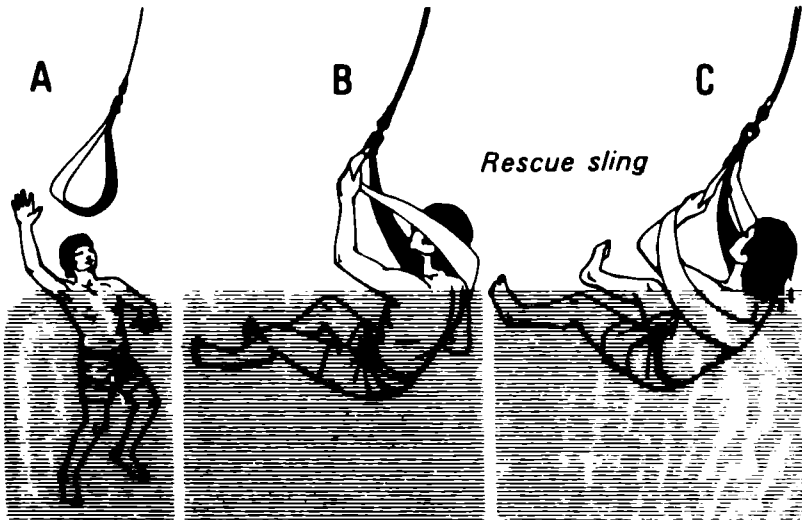
Helicopter rescues

Helicopters are well practised in rescuing survivors from either a deck or the sea. Three methods may be employed :

1. *Rescue sling (strop)*

This device, though efficient, is the most troublesome for persons not familiar with its use. The strop is a looped belt made of heavy webbing which is padded and covered with waterproof fabric. It is lowered from the helicopter on a wire rope operated from a winch. The helicopter approaches you 'into wind', so position yourself with your back to the wind and watch the aircraft approach with the strop close to the water surface. *Do not move towards the strop.* Then :

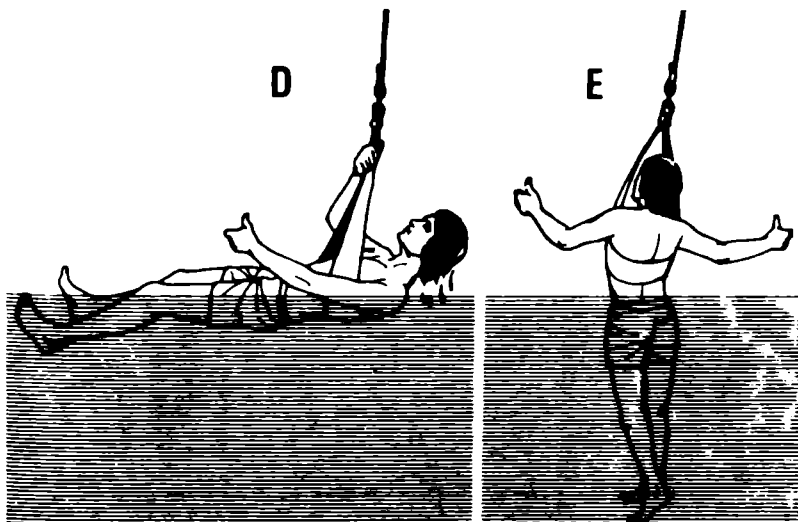
- (a) Approach the sling from the bottom or loop end (opposite the cable attachment).
- (b) Insert one arm up from under the sling.
- (c) Lower the head and other arm under the water and bring them up inside the loop. The sides of the sling are then under the armpits and the loop is across the back.



When ready to be hoisted, you raise one arm horizontally and give the 'thumbs up' signal and look up.

The winchman, on receiving the 'thumbs up' signal, starts hoisting you. When clear of the water, you may extend both arms horizontally and give the thumbs up to indicate that the winch is going successfully, or 'thumbs down' if any difficulty is encountered (in which case you will be lowered back into the water). You may then bring your arms into the sides and grasp the front of the strop at breast height in the 'rest' position. You are then hoisted level with the access door and hauled into the helicopter by the winchman using the handle attached to the back of the strop. *Don't attempt to climb into the aircraft yourself. The winchman will help you.*

While being winched in the strop don't jump about or swing unduly, as this may upset the aircraft balance. You may find that spray kicked up by the rotor blades is disconcerting, but persevere. Don't raise your arms over your head as you may slip out of the strop. Watch the winchman, and any signals he may give you. Ensure *your* signals are correct and clearly visible to the winchman.



Much the same procedure applies if the rescue is from shipboard. If an assistant is available, he should hold the sling as though he were holding a coat for someone to don. The person to be hoisted merely backs up to it; inserts one arm, and then the other; drops his arms to his waist; and clasps one wrist with the other hand.

Two things are important:

- (1) Don't sit in the sling.
- (2) Keep the yoke of the sling and the hoist cable to the front. When used in this manner you can lose consciousness and yet not fall from the sling while being hoisted.

When there is no one to assist you, remember to enter the sling as you would a coat. You insert one arm, then the head and trunk. Then twist as you would do when putting on a coat.

The same two cautions apply. Don't sit in the sling, and ensure that the yoke and cable are in front—if not, get out and try again.

2. Double lift

If you are injured or exhausted, the winchman or a diver will be lowered to pick you up. He will wear a special double lift harness so that he can be attached to the winch wire adjacent to the strop.

He will be lowered into the water by the winch controlled by the helicopter pilot. He will fit the strop to you and you will both be hoisted back aboard the helicopter.

Don't attempt to get out of this or any of the other devices. The crewman will stop the hoist, turn you as required (sometimes to face away from the door) and pull you into the cabin.





Double lift

He is well trained. Extra arms and fingers may hinder rather than help him. If more than one person is to be hoisted, the first rescued may be required to assist the operator in embarking others but you should do no more than you are instructed to do. Here again, extra arms may hinder rather than help.

If the rescue is being carried out from shipboard, *on no account should the strop or winch wire, when lowered to the*

vessel, be secured to any part of the vessel or allowed to become entangled with any rigging or fixtures. If the ship cannot comply with these conditions the helicopter may be able to lift a man from a boat towed astern on a long painter. The helicopter winch wire carries a static charge of electricity and should not be touched without rubber gloves.

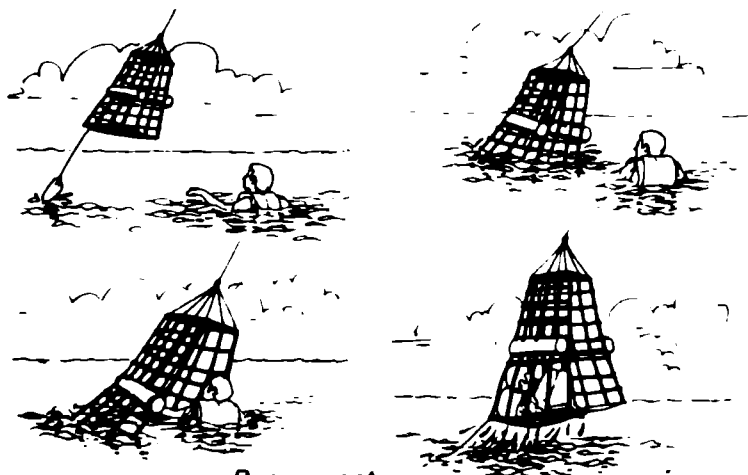
3. Rescue net

The net is a conically shaped 'bird cage' open on one side made of a strong synthetic line. Fully extended, it is 1194 mm high and 1270 mm wide, and it weighs 9 kg.

It can carry two persons at one time and can be employed for personnel rescue and light cargo transfer. Its stability is maintained by a drogue which trails behind it in the water. Foam floats provide buoyancy and frame shape.

The helicopter approaches the survivor 'into wind' (as with other rescue methods), lowering the net which will contact the water about 3 metres in front of you. The net opening will be towards you.

The net is trolled forward at from 3 to 5 knots. You should *fully* enter the net. Your weight will cause the net to tilt back and the opening to rotate so that you face aft.



Rescue net

The winchman won't wait for any signal from you, but will begin hoisting immediately you are *fully* in the net. Don't try to board the aircraft from the net. Wait until the crewman assists you into the aircraft. You *may* be retained in the net and trailed through the air to a rescue craft or land. This is quite safe.

Health

The main health hazards in the water are hypothermia and drowning. Hypothermia results from a marked reduction of body temperature. The critical temperature of water for human survival is 20°C. A naked or inadequately clad body cools quickly when immersed in cold water. The rate of cooling depends on a number of things, including the thickness of subcutaneous fat and the amount of heat it is holding when the body is immersed. In general fat people survive longer than thin people. The first parts of the body affected are its extremities. Numb fingers and hands paralysed by cold are early signs and similar effects will be noticed on toes and feet. As the core temperature of the body declines your shivering response (one of your body's ways of warning you) ceases; the muscles become rigid and speech difficult; then drowsiness precedes unconsciousness and death. To delay hypothermia keep out of the wind, keep under the water, keep still, and wear protective clothing. Survivors boarding a raft after immersion should huddle together for warmth, don any dry clothes available and wring out wet clothing layer by layer. Massage and activity will help restore blood circulation in hands and feet.

Drowning is often the result of complete collapse by hypothermia. Methods of reviving the drowning are described in Chapter 7.

On board the raft seasickness affects most people, including hardened seafarers. Take seasickness tablets if you have them, preferably before abandoning ship. But don't take them for at least 12 hours after morphine has been administered. Don't continue to drink if you vomit the fluid you are taking. Try to take your mind off your illness by doing other things. Seasickness should disappear within a few days.

Sunburn is another hazard of exposure. The skin becomes inflamed, blisters form, the lips crack, and the eyes become sore. Avoid exposing the skin to the sun. Erect the canopy if your raft has one. Improvise one if it hasn't. Keep as much of your body as possible covered with clothing. Cover your head, neck and eyes. Smear sunburn cream over exposed flesh. Use ointment from your first aid kit to soothe sunburns.

Heat stroke is caused by too much exposure to heat. The skin becomes hot and dry, the pulse rate slows, and there is diarrhoea, dizziness, fever, headache, nausea and vomiting, mental confusion and unconsciousness. To treat it, loosen the clothing and bathe the head, face, wrists and body in cool sea water. Lay the survivor in the shade and fan him.

If your hands were burnt by rope friction when abandoning ship remember that these burns are liable to sepsis. Don't touch them. Don't try to remove clothing stuck to them. Keep the burn as dry as possible and apply a sterile dressing or clean cloth immediately. If blisters form, don't prick them. If large areas of skin are burnt and you have morphine, administer it to relieve the pain. Morphine is usually provided in ampoules of 15 milligrams fitted with a needle when it is provided at all. It should be injected deep into a muscle, not just under the skin. It shouldn't be given to an unconscious person or to one having difficulty in breathing. Less severe pain may be relieved by chewing codeine tablets.

If the skin is sodden with sea water for a few days, salt-water boils, sores or ulcers may appear. They can be very painful and leave large holes. They should be kept clean and dry if possible. They shouldn't be squeezed, picked or pressed. Don't prick a blister. Clean it if it breaks and apply a dressing. If you have to choose between keeping your boils dry or your body wet to avoid dehydration, keep your body wet as dehydration is more serious. A common place for blisters and boils to develop is on the buttocks as the result of sitting for long periods in wet conditions. Try to keep the buttocks dry. Sit on as soft a seat as possible. Avoid friction but change your sitting position frequently. Calluses are also common on

buttocks and on hands. Leave them alone, but clean any skin cracks or raw areas where calluses have been removed.

Chilblains form on cold wet skin. Try to keep the blood circulating by wiggling fingers, toes and face muscles. Keep chilblains clean and dry.

Frostbite occurs at the extremities of the body when they are exposed. You cease to feel cold in the part affected. Your skin becomes hard, grey, or yellowish white. To prevent it, wiggle hands and feet, move limbs. First aid may be administered by placing the palm of a warm hand over the area and applying pressure steadily, without rubbing, or by cupping the hands over the area and breathing through them. Put frost-bitten fingers under the armpits or between your thighs.

To avoid cramp, you should flex your muscles and bend your joints whenever possible. If cramp begins to set in, knead the affected area.

In a wet, crowded lifeboat immersion foot is common. The feet swell, become numb, go white or purple, and ulcerate. Prevent immersion foot by keeping the raft bailed and the feet out of the water. Loosen your boots, wiggle your toes, flex your ankles and lift your legs up and down. Warm each other's feet by nursing them or by placing them between another person's thighs or under another survivor's armpits. Warm them slowly. Don't rub them.

If a person is wounded, cover the wound as soon as possible with sterile dressings or a clean cloth. If the wound is on a limb, lay the person down and raise the limb. This and the pressure of a bandage will help stop the bleeding. If a large artery has been severed, apply pressure over it where it enters the wound. For large flesh wounds, pack the cavity with sterile dressings, then bandage firmly.

Wounded parts will swell. If the limbs are wounded keep them raised to reduce the swelling. It may be necessary to loosen the bandages after a few hours, but don't disturb the wound dressings. If the wound is severe, treat for shock. If it becomes septic, with pain, redness, swelling and discharge, remove the dressing, wash the wound with sea water, and re-dress.

If dry gangrene develops, the affected part will become dry, dark and shrivelled. If wet gangrene develops, the part will swell, become painful and produce a foul-smelling liquid. Adjacent tissues will be inflamed and fever will develop. Keep the part clean and dry and preferably rest it in a raised position.

If an unconscious survivor is taken on board lay him on one side, leaning the body slightly towards the face-down position with the side of the face on the raft floor. Keep him in this position by bending the top leg or by supporting the trunk with folded clothing. Open the mouth and clean it if necessary. Loosen tight clothing to prevent obstruction to breathing. Don't give him a drink. Don't give him morphia. Wrap him up well if the weather is cold.

If he is suffering from shock, keep him lying down and warm but don't overheat him. Raise his legs provided there is no head injury, no difficulty in breathing and no pain when the legs are moved. If there is difficulty in breathing, keep the head and chest raised.

If a bone is broken, immobilise the fracture. Signs of a broken bone are pain and tenderness which are increased greatly by any attempt to move the part. If it is a limb, the person won't be able to move it. A broken arm can be supported in a sling or tied across the chest. A broken leg can be tied to the sound leg with padding between. If the spine is broken, place the person in a comfortable position, usually on his back, and put soft padding under the natural curves of the back. When the spine is broken in the neck region, place padding on both sides of the head to prevent any rolling movement. Every two hours gently turn him partly to one side and then the other. Support him in the new position to prevent the development of pressure sores.

If survivors are suffering from dehydration, they will soon lose their appetite for food, but if water and food are available they should eat regularly, even if they don't feel hungry. Regular meals improve morale and maintain health. If you have the choice, eat carbohydrates rather than proteins. Don't eat proteins unless you have at least a litre of water to

drink each day. Avoid salt in any form. it will hasten dehydration. If you become constipated, don't worry. Constipation conserves the water in your body. In any case, if you are surviving on emergency rations, there may be no useless residue to pass. Don't worry about loss of weight either. Some people have lost more than half their normal weight and have survived. If you get diarrhoea, don't eat. Diarrhoea can be a serious drain on your body water and can hasten dehydration. Drink as much as you can to replace the loss of fluid.

If one of your fellow survivors dies, dispose of the body promptly, but preferably at night in shark-infested waters. The signs of death are :

- No pulse in the artery behind and below the angle of the jawbone.
- The skin blanches but doesn't become pink again when you press it.
- The pupils of the eyes are large and remain large when light is directed into the eye. (They may be small, however, if morphine has been administered.)

Later you will find that :

- The muscles stay flat after being pressed.
- The body becomes cold.
- The skin is stained red-blue in parts.
- The body will become stiff as rigor mortis occurs.

Metric-imperial equivalents

APPENDIX I

length

6 mm	$\frac{1}{4}$ "
12 mm	$\frac{1}{2}$ "
25 mm	1"
50 mm	2"
300 mm	1'
450 mm	18"
500 mm	20"
900 mm	3'
1200 mm	4'
1 m	39"
1.5 m	5'
2 m	6' 6"
3 m	10'
100 m	110 yd
1 km	0.6 mile
5 km	3 miles
10 km	6 miles
20 km	12 miles
30 km	18 miles
50 km	31 miles
64 km	40 miles
100 km	62 miles
500 km	310 miles
800 km	500 miles
1000 km	620 miles

temperature

-1 °C	30 °F
0 °C	32 °F
5 °C	41 °F

temperature (cont.)

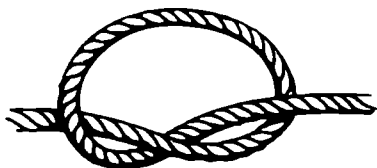
10 °C	50 °F
15 °C	59 °F
20 °C	68 °F
30 °C	86 °F
40 °C	104 °F
50 °C	112 °F
200 °C	392 °F

volume

70 ml	$\frac{1}{8}$ pt
140 ml	$\frac{1}{4}$ pt
300 ml	10 oz
500 ml	17.5 oz or 1 pt
850 ml	1 $\frac{1}{2}$ pt
1 litre	1 qt
3 litres	5 pt
4.5 litres	1 gallon
6 litres	10 pt
14 litres	25 pt
42 litres	75 pt

mass

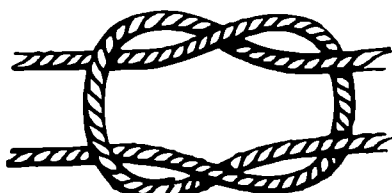
100 g	3 oz
200 g	7 oz
300 g	10 oz
1 kg	2.2 lb
2 kg	4.4 lb
25 kg	55 lb
68 kg	150 lb



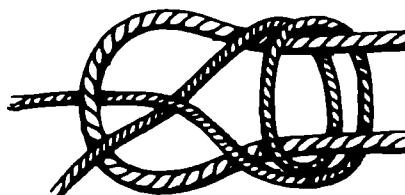
thumb knot



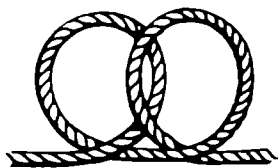
figure-of-eight knot



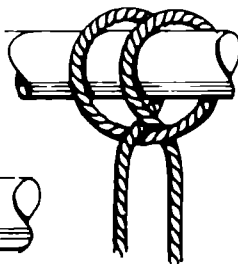
reef knot



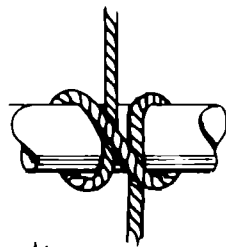
double sheet knot



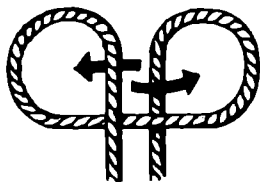
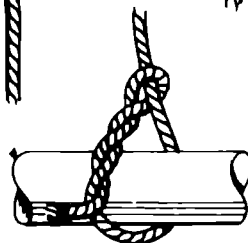
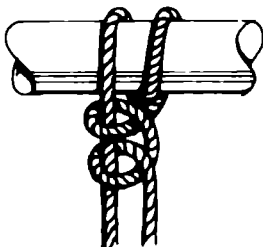
clove hitch



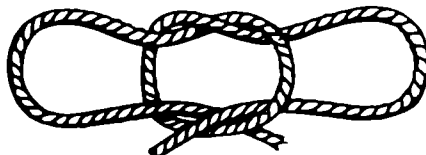
round turn and two half hitches



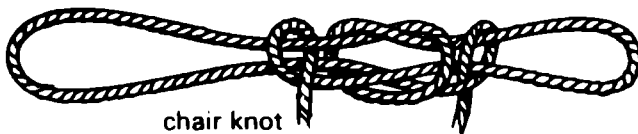
timber hitch



chair knot



bowline



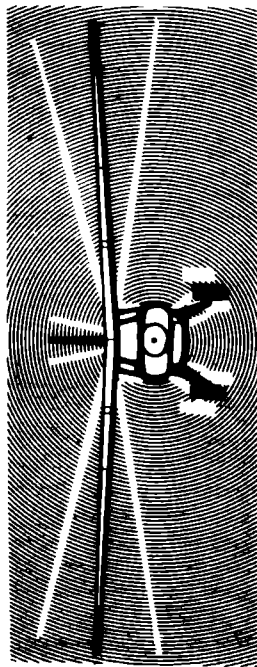
Search and rescue signals

<i>message</i>	<i>code symbol</i>	<i>message</i>	<i>code symbol</i>
Require doctor serious injuries	I	Probably safe to land here	
Require medical supplies	II	Require fuel and oil	L
Unable to proceed	X	All well	LL
Require food and water	F	No	N
Indicate direction to proceed	K	Yes	Y
Am proceeding in this direction		Not understood	JL
If in doubt use international symbol S O S			

Ground-air visual code for use by survivors

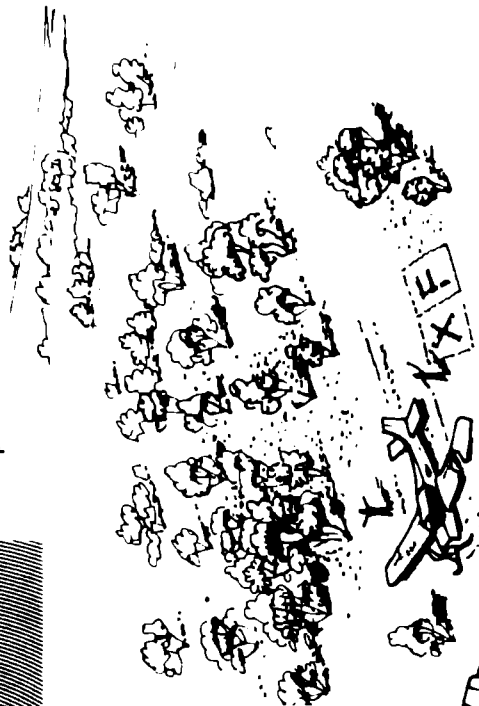
<i>message</i>	<i>code symbol</i>
Operation completed	L L L
We have found all personnel	<u>L L</u>
We have found only some personnel	++
We are not able to continue. Returning to base	X X
Have divided into two groups each proceeding in direction indicated	
Information received that aircraft is in this direction	
Nothing found. Will continue search	N N

Ground-air visual code for use by ground search parties



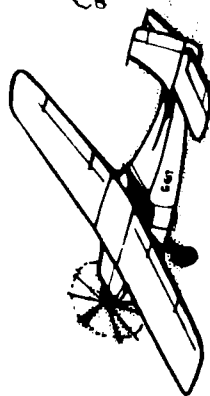
Message received and understood:

Aircraft will indicate that ground signals have been seen and understood by, in day or moonlight, rocking from side to side; at night, making green flashes with signal lamp.

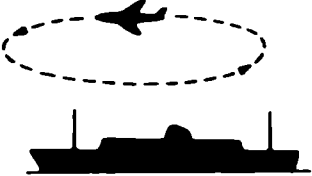
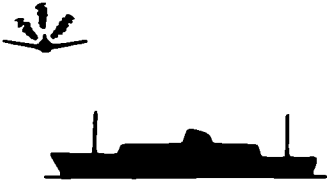
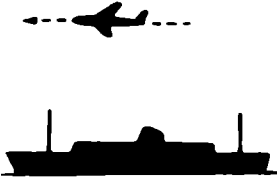
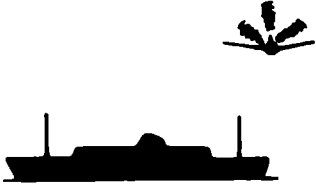


Message received and not understood:

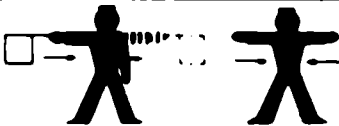
Aircraft will indicate that ground signals have been seen but not understood by, in day or moonlight, making a complete right-hand circle; at night, making red flashes with a signal lamp.



Standard aircraft acknowledgments

<i>Procedures performed in sequence by an aircraft</i>	
	1 Aircraft circles the surface craft at least once
The aircraft is directing a surface craft towards an aircraft or surface craft in distress	
	2 Aircraft crosses the surface craft course close ahead at low altitude opening and closing the throttle or changing the propeller pitch
	3 Aircraft heads in the direction in which the surface craft is to be directed
The assistance of the surface craft is no longer required	
	Crossing the surface craft's wake close astern at low altitude opening and closing the throttle or changing the propeller pitch.

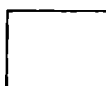
Search and rescue aircraft signals

<i>Manual signal</i>		<i>Light signal</i>
In general affirmative		
Day signals	 Vertical motion of a white flag or of the arms	 or firing of a green star signal
Night signals	 Vertical motion of a white light or flare	 or firing of a green star signal
In general negative		
Day signals	 Horizontal motion of a white flag or the arms extended horizontally	 or firing of a red star signal
Night signals	 Horizontal motion of a white light or flare	 or firing of a red star signal

Signals used from shore to small boats

You are seen— assistance will be given as soon as possible	
Day signals	  or combined light and sound signal (thunder-light) consisting of 3 single signals which are fired at intervals of approximately one minute Orange smoke signal
Night signals	 White star rocket consisting of 3 single signals which are fired at intervals of approximately one minute (Repetition of such signals have the same meaning)

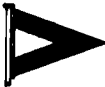
Lifesaving signals

Code flag	A 	B 
C 	D 	E 
F 	G 	H 
I 	J 	K 
L 	M 	N 
O 	P 	Q 
R 	S 	T 
U 	V 	W 
X 	Y 	Z 
 Answering Pennant		

International code of signals

Numeral pennants		1 
2 	3 	4 
5 	6 	7 
8 	9 	0 

The first substitute always repeats the upper flag or pennant of a hoist; the second substitute repeats the second flag or pennant and so on.

Substitutes	First substitute 
Second substitute 	Third substitute 

Carrying the injured

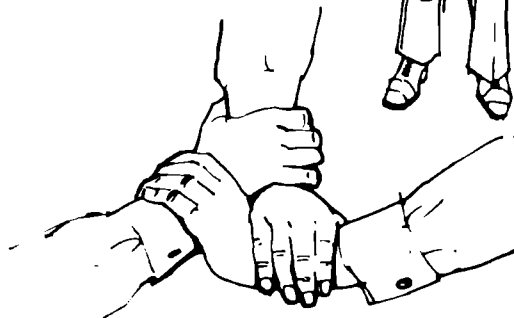
APPENDIX IV



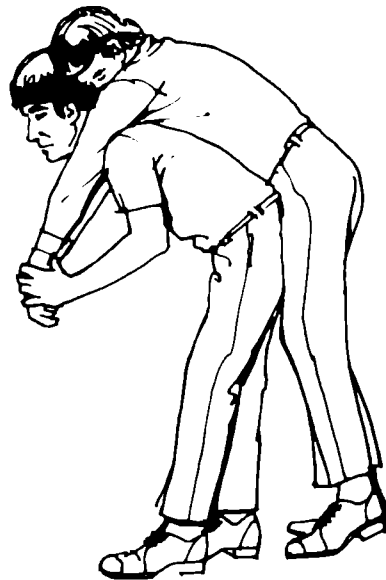
One-man human crutch



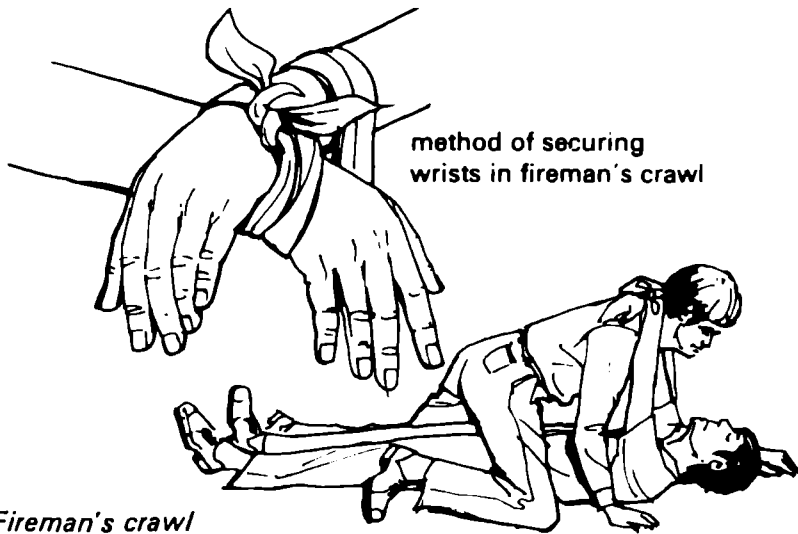
Arm lift



Three-handed seat

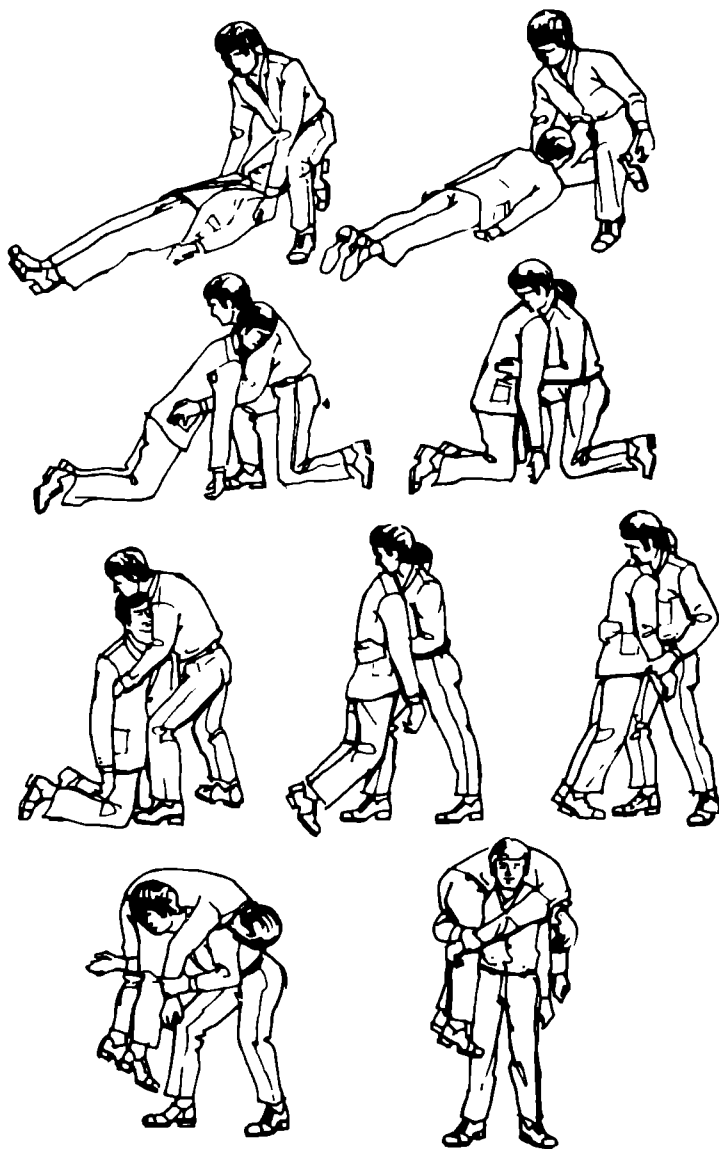


Pick-a-back

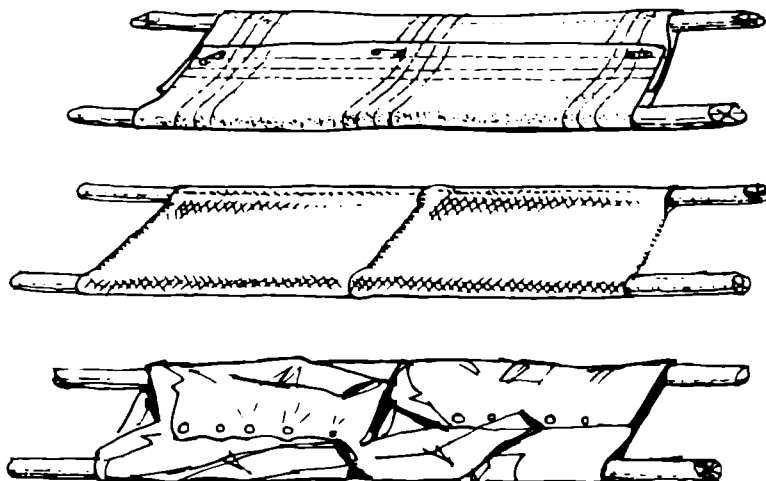


method of securing
wrists in fireman's crawl

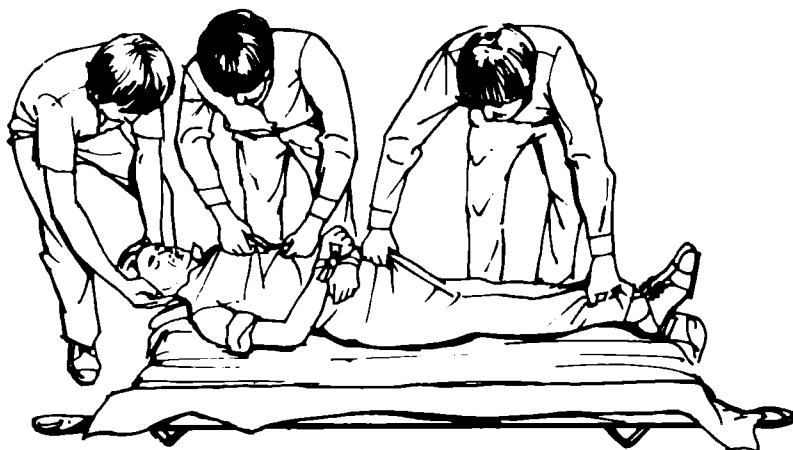
Fireman's crawl



Fireman's lift



*Improvised stretchers using poles and
a blanket, sacks or coats*



Clothing lift method of stretcher loading

Community counter disaster preparedness

APPENDIX V

Introduction

The best form of defence against disaster is that offered by an effective local counter disaster organisation. Such an organisation can be decisive in containing and controlling the disaster, reducing casualties and damage to property, and starting the community on the road to recovery.

Do not rely on help coming quickly from outside your local community. Events elsewhere, and local damage to roads, airfields, bridges and other facilities, may prevent or delay such assistance. Where help has to come from a distant source, it may not come as quickly as you need it. In disasters, there is no substitute for immediate, local self-help.

Fundamental requirements

There are three fundamental requirements for counter disaster preparedness in any community.

1. Local officials and community leaders, with a designated Local Controller or Co-ordinator, should prepare plans to meet disasters likely to arise in their community. All the necessary organisations should be brought together in these plans. The plans should be tested in exercises that simulate a range of possible disaster situations, so that key members and local organisations are practised in their responsibilities and so that the soundness of the plans can be tested.
2. An Emergency Operations Centre (EOC) should be established. The Controller or Co-ordinator, his small supporting staff and other key members can concentrate in the EOC, into which vital disaster information will flow and from which the necessary counter disaster measures

can be initiated and controlled. The EOC should be located in a safe area and building, and also be tested in exercises.

3. Arrangements should be made to keep the local community supplied with information on what to do, what specific preparations to make, what is happening and how assistance can be obtained.

In summary, effective counter disaster preparedness in any community calls for :

- well-developed and co-ordinated plans and a disaster organisation which have all been tested ;
- a designated, properly equipped Emergency Operations Centre ; and
- a positive and comprehensive community information program.

Select bibliography

Bureau of Meteorology, *The cyclone warning system*, Australian Government Publishing Service, Canberra, n.d.

Canada—Royal Canadian Air Force Survival Training School, *Down but not out*, Queen's Printer, Ottawa, 1970.

John B. Cleland and R. V. Southcott, *Injuries to man from marine invertebrates in the Australian region*, National Health and Medical Research Council, Canberra, 1965.

A. B. and J. W. Cribb, *Wild food in Australia*, Collins, Sydney, 1974.

Carl Edmonds, *Dangerous marine animals of the Indo-Pacific region*, Wedneil Publications, Newport, Vic., n.d.

Federated Mountain Clubs of New Zealand, *Death by exposure*.

—, *Safety in the mountains*.

J. Ros. Garnet, *Venomous Australian animals dangerous to man*, Commonwealth Serum Laboratories, Parkville, Vic., 1968.

The good camping omnibus, K. G. Murray, Sydney, 1976.

Richard Graves, *The ten bushcraft books*, Dymock's Book Arcade, Sydney, n.d.

Hobart Walking Club, *Safety in the bush*, 5th ed., Hobart, 1973.

H. A. Lindsay, *The bushman's handbook*, Jacaranda Press, Brisbane, 1963; also Angus and Robertson, Sydney, 1948.

W. K. Merrill, *The survival handbook*, Winchester Press, New York, 1972.

- Natural Disasters Organisation, State Emergency Service, Northern Territory Disaster Council, Bureau of Meteorology, *Living with cyclones*.
- P. H. Nesbitt, Alonzo W. Pond and William H. Allen, *The survival book*, Van Nostrand, Princeton, N.J., 1959.
- Paddy Pallin, *Bushwalking and camping*, 9th ed., Sydney, 1973.
- M. W. Plate, *Australian bushcraft*, Lansdowne Press, Melbourne, 1971.
- Royal Australian Navy, *The survival manual*, Navy Office, Canberra, 1968.
- John Stackhouse, *Australia's venomous wildlife*, Paul Hamlyn, Sydney, 1970.
- Robert C. Suggs, *Survival handbook*, Macmillan, New York, 1962.
- Touring Committee of the N.S.W. Ski Association, *An introduction to ski touring*.
- Department of Transport, *Marine information manual: Australia*, AGPS, Canberra, 1975.
- , *Safety for small craft*, AGPS, Canberra, 1970.
- , *Distress procedures for small craft*, AGPS, Canberra, 1975.
- United States Air Force, Air Force Manual 64-5, *Search and rescue survival*, U.S. Government Printing Office, Washington, 1962.
- Western Australia—Police Department, *Aids to survival*, issued by the Commissioner of Police, Perth, 1970.
- David R. Wright, *Survival*, Penguin, Harmondsworth, 1974.

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